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COPY FOR MR. J. ALLAN ROSS



HYDRO-ELECTRIC INQUIRY COMMISSION

ENGINEERING DATA

THE QUEENSTON-CHIPIAWA POWER DEVELOPMENT

CHAPTER "E"—GENERAL DESCRIPTION

WALTER J. FRANCIS, C. E.

CONSULTING ENGINEER









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CHAPTER "E".

GENERAL DESCRIPTION.



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10. The following table gives the number of hours per week spent by students in various activities.

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(B-11ms.)

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Chapter E.

GENERAL DESCRIPTION.

In addition to the right-of-way and crossings, which may be considered as common to the whole project, the Queenston-Chippawa Power Development consists of seven principal elements working in proper co-relation to provide the means of converting the potential energy of the water of the Niagara River into electrical energy. The seven elements may be briefly described as,-

(a), the Intake, through which water is diverted from the Niagara River into the Welland River;

(b), the Welland River, where the improved river channel is utilized for the passage of the water;

(c), the Canal, which conveys the water from the Welland River, to the forebay near the Power House;

(d), the Forebay, where the water is spread out or distributed over a relatively wide area;

(e), the Screen House, where the water is diverted into various channels leading therefrom;

(f), the Penstocks, being the steel tubes or pipes carrying the water from

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the Screen House over the cliff down to the turbines; and

(g), the Power House, in which are located the turbines and the generators for converting the hydraulic energy into electrical energy.

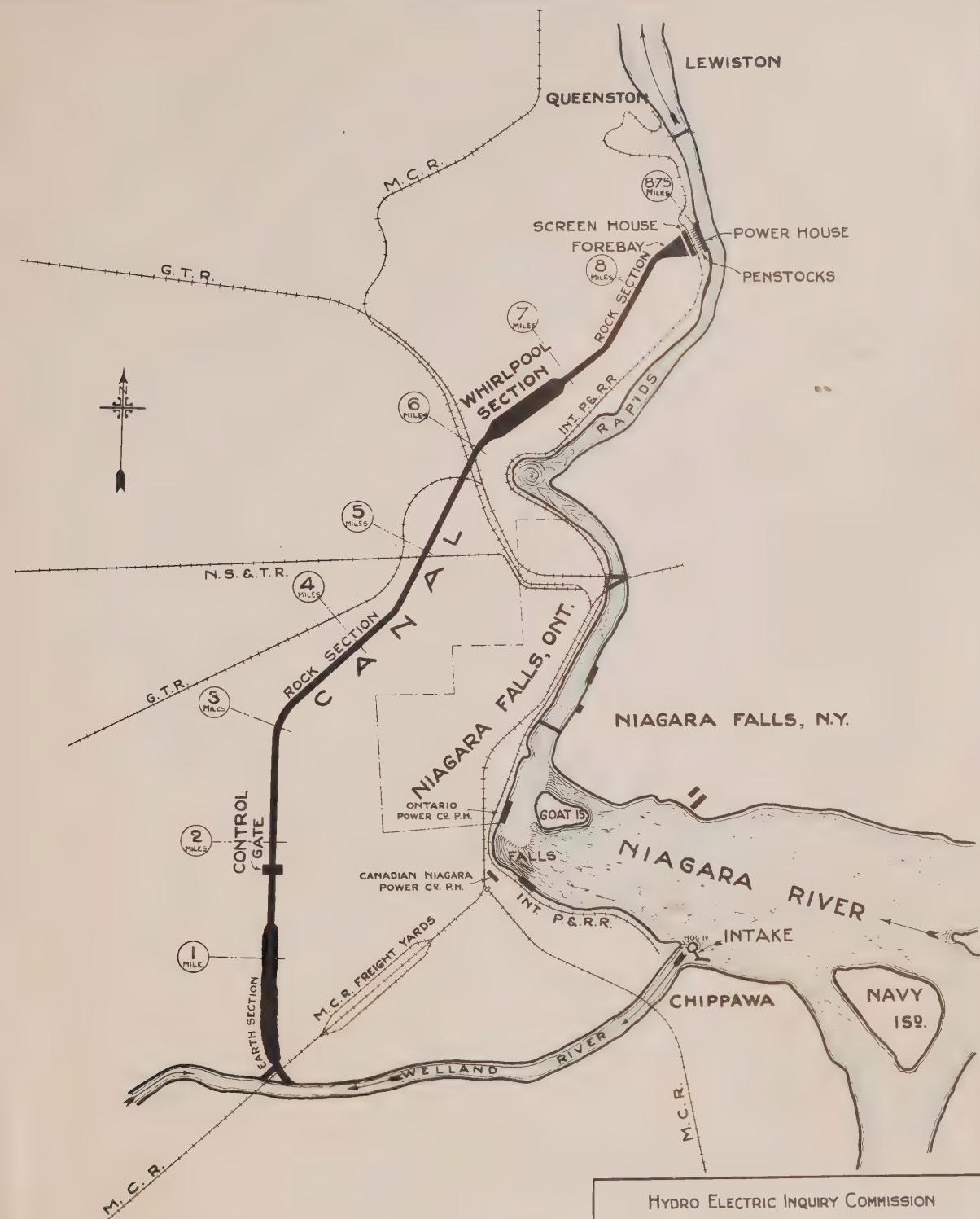
The general location of the various elements of the development with regard to the adjacent country is shown on the "Plan of Vicinity" included as page B-3. The right-of-way and crossings will be dealt with at the conclusion of this Chapter.

The Intake.  
**COPY**

The Intake is situated at the mouth of the Welland River, sometimes referred to as Chippawa Creek, adjacent to the Village of Chippawa, about two miles above the Falls of Niagara. The Niagara River at this point has a width of about one and one-quarter miles, and the mouth of the Welland River is at the inner end of a wide bay, and is divided into two channels by Hog Island. Close to the opposite (New York) shore of the river, there is a small island, known as Grass Island, hence the reference to this section of the Niagara River as the Chippawa-Grass Island Pool. The general location of the Intake with regard to the neighbouring parts of the Province of Ontario, and to the State of New York, and also with regard to Lake Erie and Lake Ontario, is indicated on the "Map Showing Location of Development", included as page B-4, and the details of the Niagara River, in the vicinity of the Intake are shown on the plan "Location of Intake", included as page B-5. An aeroplane view of the mouth of the

#### 2. *Antennae*

10



HYDRO ELECTRIC INQUIRY COMMISSION

W.D. GREGORY, — CHAIRMAN

QUEENSTON-CHIPPAWA POWER DEVELOPMENT

## PLAN OF VICINITY

Scale of Miles

Toronto, May 16th, 1922      Made by CM&Q Checked by <sup>1/2</sup>

WALTER J. FRANCIS, C.E.,  
CONSULTING ENGINEER.



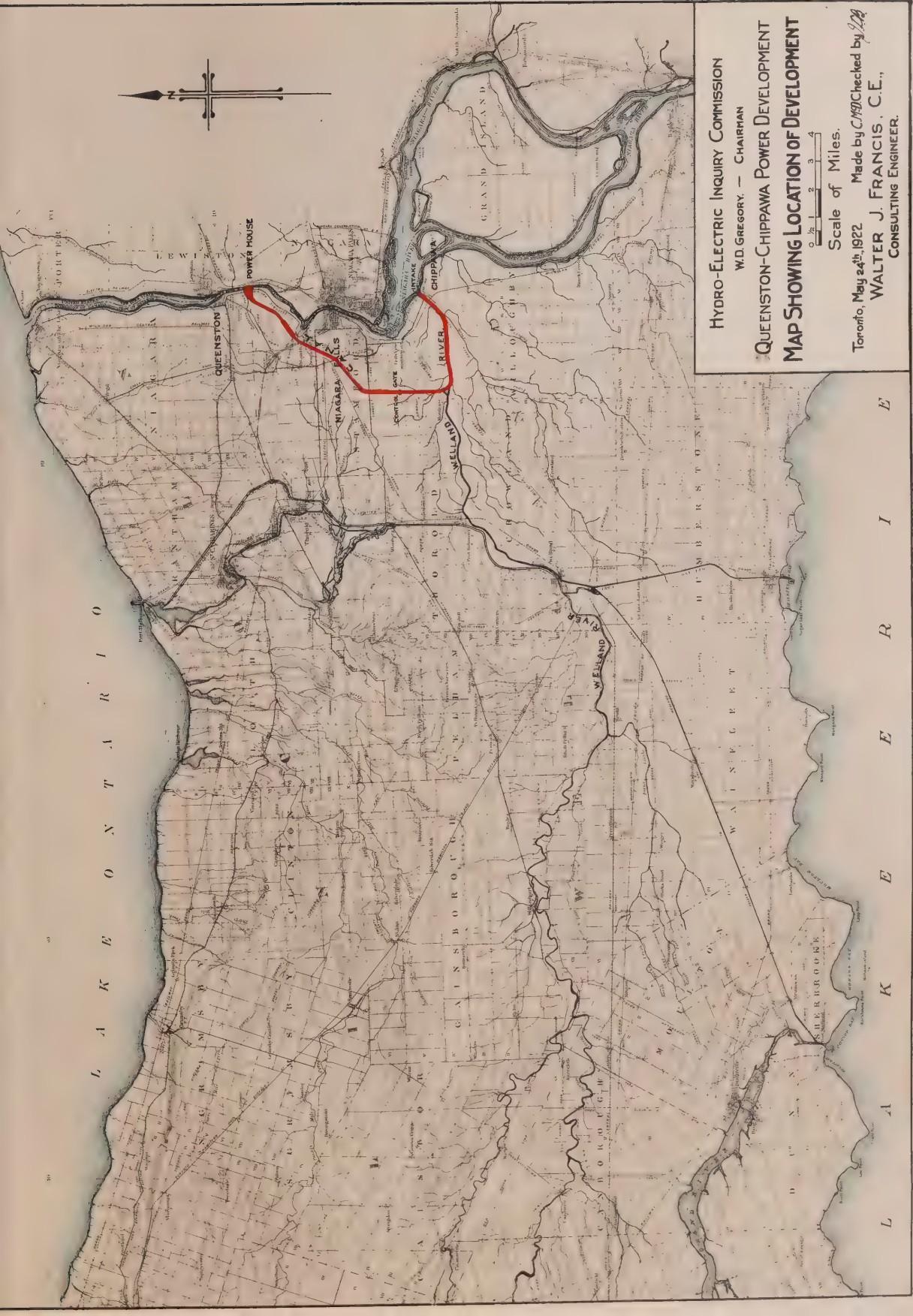
**HYDRO-ELECTRIC INQUIRY COMMISSION**  
**W.D. GREGORY. — CHAIRMAN**  
**QUEENSTON-CHIPIWA POWER DEVELOPMENT**  
**MAP SHOWING LOCATION OF DEVELOPMENT**

Scale of

Miles.

Made by C.M.C. Checked by J.L.  
**WALTER J. FRANCIS, C.E.,**  
 CONSULTING ENGINEER.

Toronto, May 24<sup>th</sup>, 1922.





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N

**LIST OF POWER PLANTS**

1	ONTARIO POWER CO.
2	INTERNATIONAL RAILWAY CO.
3	CANADIAN NIAGARA POWER CO.
4	ELECTRICAL DEVELOPMENT CO.
5	HYDRAULIC POWER CO.
6	NIAGARA FALLS POWER CO.



HYDRO-ELECTRIC INQUIRY COMMISSION  
W.D.GREGORY-CHAIRMAN  
QUEENSTON-CHIPPWA POWER DEVELOPMENT  
**MAP OF NIAGARA RIVER SHOWING LOCATION OF INTAKE.**  
Scale as Indicated.

Toronto June 22<sup>nd</sup> 1922. Made by HPA Checked by *W.D.G.*  
WALTER J. FRANCIS, C.E.  
CONSULTING ENGINEER



WALTER T. GEYER & COMPANY

GENERAL AGENTS FOR THE  
AMERICAN FEDERATION OF MR. J. E. DELLACK BOOG

100 BROADWAY NEW YORK CITY

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To face page 2-6.

No. 2-1

Photograph showing  
~~General View of Inlet Excavation Work.~~  
**COPY**  
looking westerly along Welland River from aeroplane.

Taken September 23rd, 1921.





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(1-7)

Welland River, taken during the construction of the Intake, is included as page N-6.

During the years 1918 and 1919 intensive studies were made by the engineers of the Hydro-Electric Power Commission in order to determine the best form of intake structure to meet the peculiar and varying conditions that might be expected to obtain from time to time. These studies were carried out not only theoretically but also by means of experimental models built in the Dufferin Islands Channel of the Niagara River to a scale of one-twentieth full size. In addition, as referred to in detail in the chapter entitled "Advisory Reports", the Hydro-Electric Power Commission obtained the advice of consulting engineers in private practice, who also made special studies. The problem which confronted the engineers was the designing of an intake structure which would divert water from the channel of the Niagara River into that of the Welland River with minimum hydraulic losses, and at the same time act as a barrier to prevent the passage of ice from the Niagara River into the proposed Canal. Finally, a design devised in collaboration with the engineers of the Hydro-Electric Power Commission by R. D. Johnson, consulting hydraulic engineer, New York, was adopted, but the present plans of the Hydro-Electric Power Commission provide only for the construction of a portion of the structure.

**COPY**

A plan showing the present and possible future construction entitled "Intake, Plan and Sections", is included herewith as page N-8. The structure is located on the south-easterly channel of the Welland River, which has been considerably widened by the removal of part of Hog Island. When the Intake will have been completed, the north-westerly channel, on the opposite

From the evidence it is evident that the hydrochloric acid solution caused greater loss than

alkali.

It would seem that nitration and reduction are relatively more influential than the acid and alkali while chlorination probably has relatively less power to influence residual

losses from the samples after a month's aging. Since no water-soluble chlorine was detected

absorption was not taken account of, the results of water-soluble chlorine may be slightly off

scale. It is apparent that the nitrogen and "Dinitro" groups had the largest decreasing

percentage conversion and their original value was about 60% of the theoretical maximum

conversion, while the others had relatively higher percentages. These differences were

noted above and the differences between the two percentages were also greatest for both

the acid and alkali and the least for the water-soluble chlorine. This suggests that acid and alkali

will decompose the ester and reduce the chlorine compound, and that the water-soluble

chlorine will decompose the ester and reduce the chlorine compound, and that the water-

soluble chlorine will decompose the ester and reduce the chlorine compound, and that the water-

soluble chlorine will decompose the ester and reduce the chlorine compound, and that the water-

soluble chlorine will decompose the ester and reduce the chlorine compound, and that the water-

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soluble chlorine will decompose the ester and reduce the chlorine compound, and that the water-

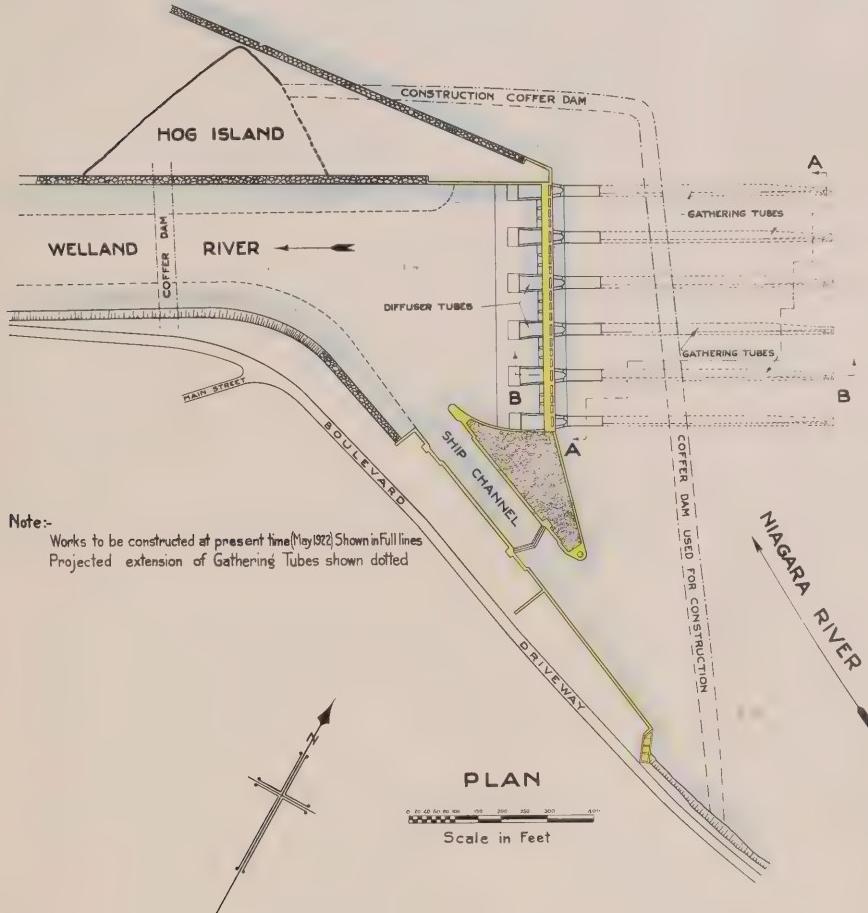
soluble chlorine will decompose the ester and reduce the chlorine compound, and that the water-

soluble chlorine will decompose the ester and reduce the chlorine compound, and that the water-



SECTION B-B

Scale in Feet  
0 10 20 30 40 50 60 70 80 90 100



SECTION A-A  
Scale in Feet  
0 10 20 30 40 50 60 70 80 90 100



TOP OF DECK ELEVATION 567.0

SECTION B-B  
Scale in Feet  
0 10 20 30 40 50 60 70 80 90 100



HYDRO-ELECTRIC INQUIRY COMMISSION

W. D. GREGORY - CHAIRMAN

QUEENSTON-CHIPPAWA POWER DEVELOPMENT  
INTAKE, PLAN & SECTIONS

Scales As Indicated

Toronto, June 6th, 1922      Made by Q.M.D. Checked by *[Signature]*

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CONSULTING ENGINEER



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(B-9)

side of Hog Island will be dammed by means of an earth fill.

The Intake as adopted, consists essentially of two parts; first, a simple culvert opening which may be used for the greater part of the time, and second, a series of special subsidiary gathering tubes, which may be used to collect water free from ice during such time as that part of the river is ice-laden.

The first part of the Intake consists of a series of five groups of piers, each of which groups provides three openings each with a clear waterway 18 foot wide by 28 foot high, thus giving a total area of opening of 7,500 square feet. The top of each of the openings is eight feet below the water level so as to deflect substances floating on the water. In addition, adjustable drop gates will permit the submergence to be increased to any desired depth. The second part consists of six "gathering tubes" located 100 feet apart, spaced between and on either side of the groups of openings referred to above, and inclined upstream at an angle of about forty-five degrees with the Niagara River. As shown on the drawing on page B-6, the gathering tubes are 675 feet in length, and for the outer 500 feet are provided with a slot on the upstream side through which they collect water from near the bed of the river. The gathering tubes are to be of concrete with a circular section. At the inner end, each gathering tube changes its section somewhat, forming a "diffuser" passing through the structure containing the culvert openings, and providing a means of spreading the water into the river channel. The present plans, however, do not provide for the construction of the gathering tubes, but only for the diffusers and the pier structure.

At the shore or south-easterly end of the main Intake there is to be constructed, at the request of the Dominion Government, a concrete lock, 80 feet in

with whom he has come up against all the time, and he also  
stated it would prove both an epithelial and mesothelial carcinoma. He stated well  
planned and well-timed surgery will now prove to give you better prognosis because  
removal of breast will give you better quality chemotherapy. Because we believe a  
radiation will suffice with the same care as would other removal and surgery would  
possibly be required with the removal of the lymphatic system and the breast are P.T. & C.  
that all cancerous parts in this area should receive equal therapy. I have had  
many cancers myself, I have undergone the same kind of radiation, and I have had CT's and  
I am not afraid to undergo what would help my prognosis and to cure the right side  
now and afterwards continue. **Y403** I am going to undergo the same type of  
treatment and I am going to get through this with the same kind of treatment and planning after  
removal breast which will be used "radiotherapy" like the other one  
will replace the breast and remove evidence. The surgery will be able to take us the  
breast and nothing else will stay intact, although there is no chance to do anything  
with the removal of the breast that will affect anything with what type of treatment will not  
affect breast like chemotherapy and no radiotherapy will not affect the breast and  
if not it will not affect the breast and the other will not have any kind of side effect upon the  
breast because there will not be any evidence left in the breast. The  
removal will remove nothing from the breast or nothing from the body. There will remain nothing  
but the breast, but the breast is gone, nothing remains but the breast and the  
breast will remain with the removal of the breast and nothing left behind with the removal  
but not in the breast which does not the new growths because the breast will be  
in fact all gone because a complete removal was done and the problem

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(E-10)

width, in order to accommodate navigation in the Welland River. At the opposite or north-westerly end, the intake structure is connected by means of a concrete wing-wall and earth fill to the Niagara River side of Hog Island.

Inland from the intake structure, the sides of the Welland River are to be finished with slopes of two horizontal to one vertical, covered with rip-rap, and a gradual transition made to the standard improved section of the Welland River channel, 150 feet in width at the bottom.

The photographs on page E-11 show the temporary dam enclosing the intake, and the excavation methods employed prior to the letting of the present contract.

## C O P Y

### The Welland River.

Prior to the construction of the power development, the natural flow of the Welland River was in an easterly direction from Montrose to Chippawa. The slope of the River, however, was so slight that no difficulty was encountered in reversing the direction of flow by withdrawing water at Montrose through the Canal, thus taking Niagara River water through the Welland River channel from Chippawa to Montrose. The natural flow of the Welland River from the watershed west of Montrose, also passes into the Canal through a westerly channel at the south end of the earth section of the Canal.

That portion of the Welland River between Chippawa and Montrose had not sufficient capacity to take care of the required flow without serious hydraulic

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To face page E-11

No. E-2

Photograph showing  
Temporary Dam, and Intake Reservation,  
looking northerly.

Taken July 19th, 1921

C O P Y

No. E-3

Photograph showing  
Temporary Dam, and Intake Reservation,  
looking easterly.

Taken July 19th, 1921





losses, and the bed of the river was therefore dredged to a width of 160 feet, with side slopes of two horizontal to one vertical, the alignment at banks being improved where necessary. The excavation was carried down to Elevation 532.5 at the Intake, and Elevation 530.0 at the commencement of the Canal, with a slope of 0.000119, corresponding to 0.63 feet per mile, between these points, providing an average depth of 23 feet at low water. The total length of the improved section is 21,000 feet or nearly 4 miles. The character of the River with the spoil-banks may be clearly seen by reference to the aeroplane photograph on page B-6, already referred to.

At the easterly end of the Welland River section, in the village of Chippawa, there are two bridges, namely, the Chippaway Highway, and the Michigan Central Railroad. The former of these was entirely rebuilt, while the latter was lengthened by the addition of two plate-girder spans.

The general location of this section of the River, together with the profile of the bed of the River and the excavated cross-section, is shown on the drawing included as page B-13.

#### The Canal.

The Canal commences at a point on the Welland River near the village of Montrose and adjacent to the crossing of the Welland River by the Michigan Central Railroad, Welland-Niagara branch, about 21,000 feet from the junction of the Welland and Niagara Rivers. Thence the Canal follows a northerly di-

(188)

and the absence of violent incidents was reflected by the fact that the general and more or less complete self-confidence of the population after the assault made the 1979 incidents of such violence were not repeated but a continuation of the trend and already from the autumn of 1979 there were better relations between students and the public than before. After the first year of independence, however, the trend of increasing social conflict, which had continued in the Soviet system, reappeared again and the situation became even worse. This was due to the fact that the traditional system of education was unable to respond to the new situation and therefore continued with the same methods of education and gave emphasis to the transmission of knowledge and the retention of knowledge about society and its development.

The situation did not improve until the **1980** when the government and the universities were forced to introduce the so-called "student self-government" and the students' demands for reforming the educational system were met. The introduction of the self-government system was a major step forward in the educational process and it has been followed by many other reforms in the educational system. The students' self-government system has been introduced in all schools and universities and has proved to be successful in addressing the problems of the educational system and has proved to be good for the students.

*Self-government in educational system and*

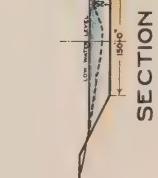
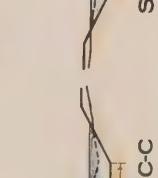
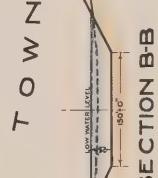
*the educational system*

The students' self-government movement has been an important factor in the development of the educational system. It has helped to increase the participation of students in the educational process and has provided the students with the opportunity to express their views and ideas. The self-government system has been successful in addressing the problems of the educational system and has proved to be good for the students.

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W.D. GREGORY - CHAIRMAN  
QUEENSTON-CHIPPANA POWER DEVELOPMENT  
PLAN SHOWING EXCAVATED CHANNEL  
OF WELLAND RIVER**

Scales As Indicated  
Toronto, 28<sup>th</sup> June 1922  
WALTER J. FRANCIS, C.E.,  
CONSULTING ENGINEER

Made by ~~W.H.~~ Checked by ~~W.H.~~  
1/2

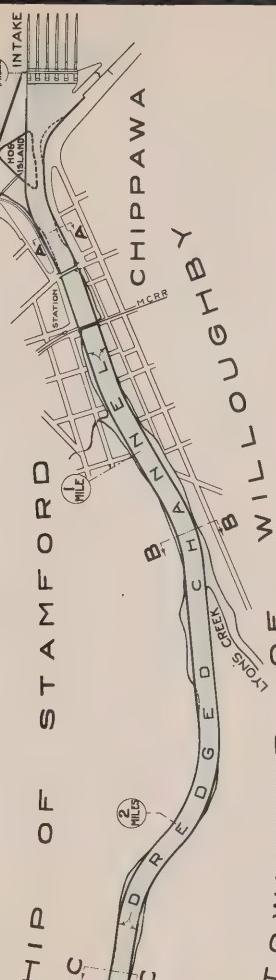


Scale of Feet for Sections

Scale of Feet

1000  
800  
600  
400  
200  
0

**PLAN**



**PROFILE**

Scales As Indicated





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(B-14)

rection to a point about three-quarters of a mile west of Winery Road in the Township of Stamford, a distance of about 3-1/3 miles. It then turns in a north-easterly direction, crossing Winery Road and Victoria Street, again deflecting towards the north at a point in the vicinity of Portage Road. From the curve at Portage Road, the Canal follows a straight line for a distance of 1-1/3 miles to a point immediately north of the Grand Trunk and Michigan Central Railways, opposite the Niagara Whirlpool, near the south side of Bowman's Gully. Crossing the gully, the Canal follows a north-easterly direction for 1-1/3 miles, and then a northerly direction for about one mile, and finally an easterly direction for about one-quarter of a mile to the entrance of the Forebay immediately above the Screen House, below which is the Power House itself. The Power House is located on the Niagara River immediately above Smeaton's Cove, at a point about one mile above the suspension bridge at Queenston.

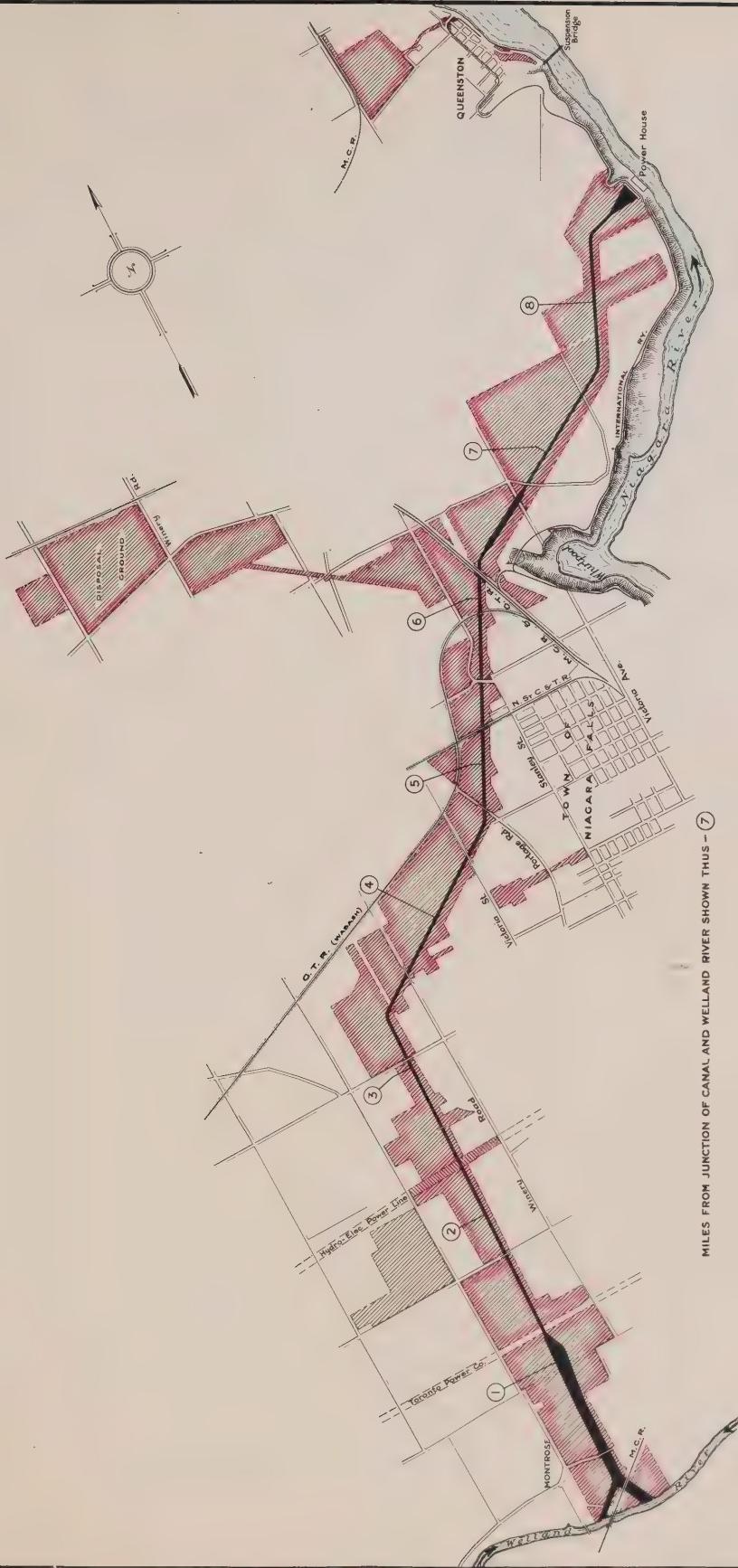
**COPY**

The general location of the Canal as described above is shown on the "Map Showing Location of Development", included herewith as page B-4, while the detail location is indicated on the "Location Plan" included herewith on page B-15. The "Location Plan" also shows the lands retained for construction purposes, and for the right-of-way adjacent to the Canal, bordered in pink. This location was determined after careful topographical surveys and studies of the contours and other natural features of the country had been made, and also after investigating the comparative economy of alternative tunnel projects. The northerly end of the Canal location was determined by placing the Power House as far south in the Niagara River as was consistent with reaching the level of Lake Ontario within practical limits.



Hydro-Electric Inquiry Commission  
W.D. GREGORY - CHAIRMAN  
QUEENSTON-CHIPPAWA POWER DEVELOPMENT  
**LOCATION PLAN**

Toronto, June 17th, 1922, Made by *[initials]*, Checked by *[initials]*  
Scale of Feet  
4000 3000 2000 1000 5000



WALTER J. FRANCIS, C.E.  
CONSULTING ENGINEER



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1928

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COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-16.

No. E-4

Photograph showing

**COPY**

Character of Country Traversed by Canal.

Looking northerly along central part of Canal from aeroplane.

Taken September 23rd, 1921.





COMMERCIAL BANK OF CHINA

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To face page B-17.

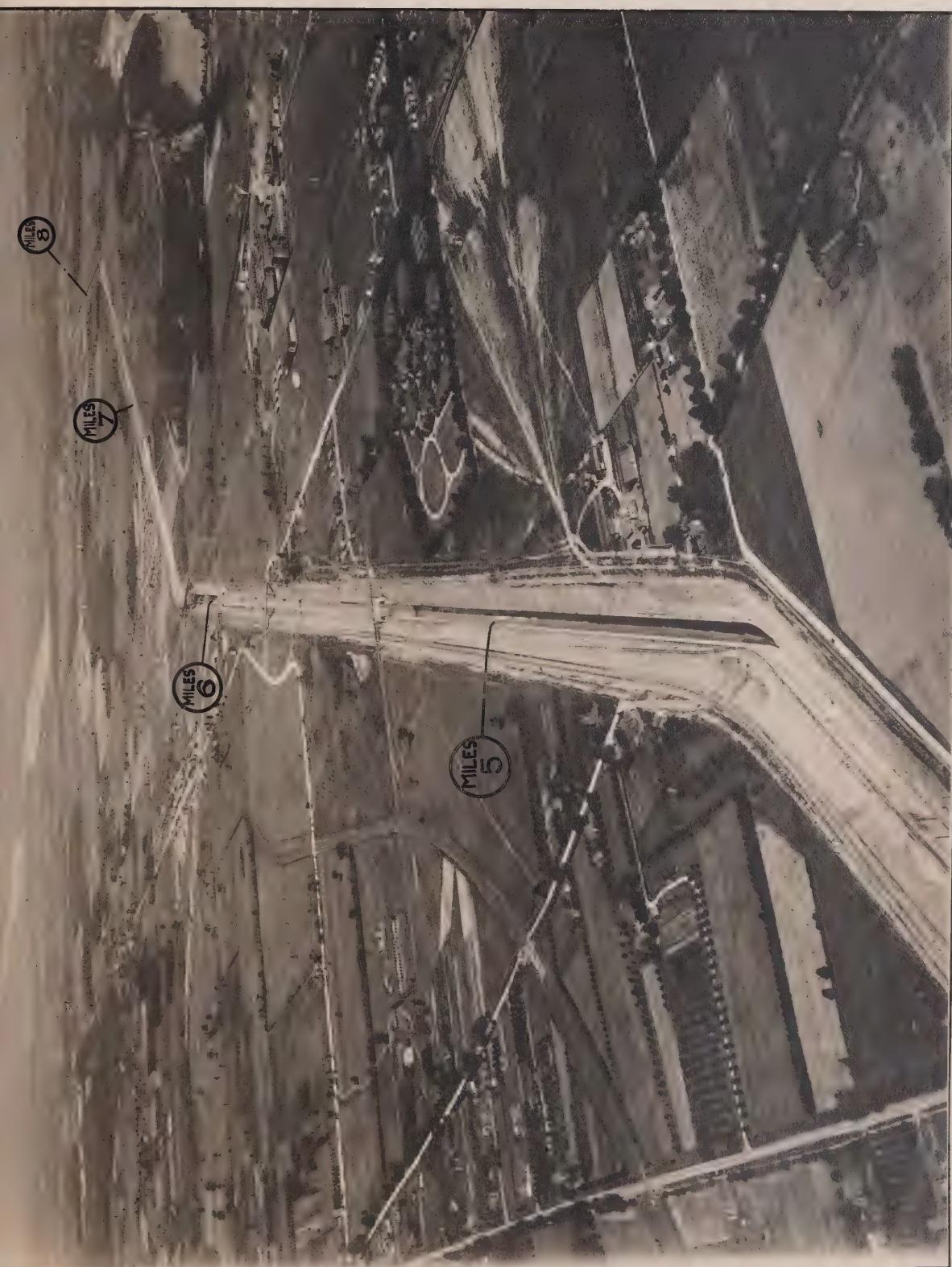
No. B-5

Photograph showing

~~Character of Ocean Improvement Canal.~~

~~COPY~~  
looking northerly along central part of Canal from aeroplane.

Taken September 23rd, 1921.





Generally speaking, the Canal passes through a country highly developed for agricultural purposes, and for fruit growing. It would not have been possible to avoid valuable territory. The general character of the country is shown on the aeroplane photographs on pages E-16 and E-17.

Provision has been made for bridges over the Canal for the majority of the highways existing prior to its construction, and for all of the railways. It is proposed to provide a total of nine highway bridges and five railway bridges.

The Canal as at present constructed, was designed for a flow of 15,000 cubic feet of water per second, but since it has been put into operation the engineers of the Hydro-Electric Power Commission have made further study of such elements of their calculations as prior to the construction of the Canal could only be theoretically determined, and have reached the conclusion that the ultimate capacity of the Canal as now built will in all probability reach 18,000 cubic feet per second.

The total length of the Canal from the intersection of its centre line with the centre line of the Welland River to the beginning of the Forebay, is 45,384 feet or 8.58 miles. For the purposes of description, it may be divided into the following sections:-

	From Station	To Station	Length
Earth Section.....	0+00 .....	64+00 ....	6,400 ft.
Southerly Rock Section.....	64+00 .....	329+50 ....	26,550 ft.
Whirlpool Section, including Transitions.....	329+50 .....	354+00 ....	2,450 ft.
Northerly Rock Section.....	354+00 .....	452+84 ....	9,884 ft.

(100-40)

should begin again in different areas about and continue off-line and without me and the others in - which were very interesting. Definitions and the state of research and the comments by myself, especially concerning the nature of the data and the methods of analysis will be quite good. I would like to add that the first 100 hours of programming was done with the greatest care and attention and I believe that value does not end there and in the next few years we can expect that all of these methods developed and used will have improved greatly to meet the needs of many off-line users. At the same time, I feel that the development of the system will be continued with the same care and attention that has been given to the first 100 hours. I would like to add that the system is still far from finished and we plan to continue to work on it for several more years. I would like to add that Anthony and his colleagues have been very helpful and supportive. I think that much information can be learned from the experience of working with them.

Object	Method	Results	Comments
100 hours	see 100 hours	see 100 hours	see 100 hours
100 hours	see 100 hours	see 100 hours	see 100 hours
100 hours	see 100 hours	see 100 hours	see 100 hours
100 hours	see 100 hours	see 100 hours	see 100 hours

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(B-19)

The relative locations of the various sections are shown on the "Plan of Vicinity", included as page B-8, and the location in detail is shown on the plan entitled "Location Plan" included as page B-15.

On page B-20 is included a drawing entitled "Profile and Sections of Canal", which indicates the location on the profile of the various sections, together with the earth surface, the rock surface and the extent of the concrete lining. Typical cross-sections at various points of the Canal are also shown on this drawing.

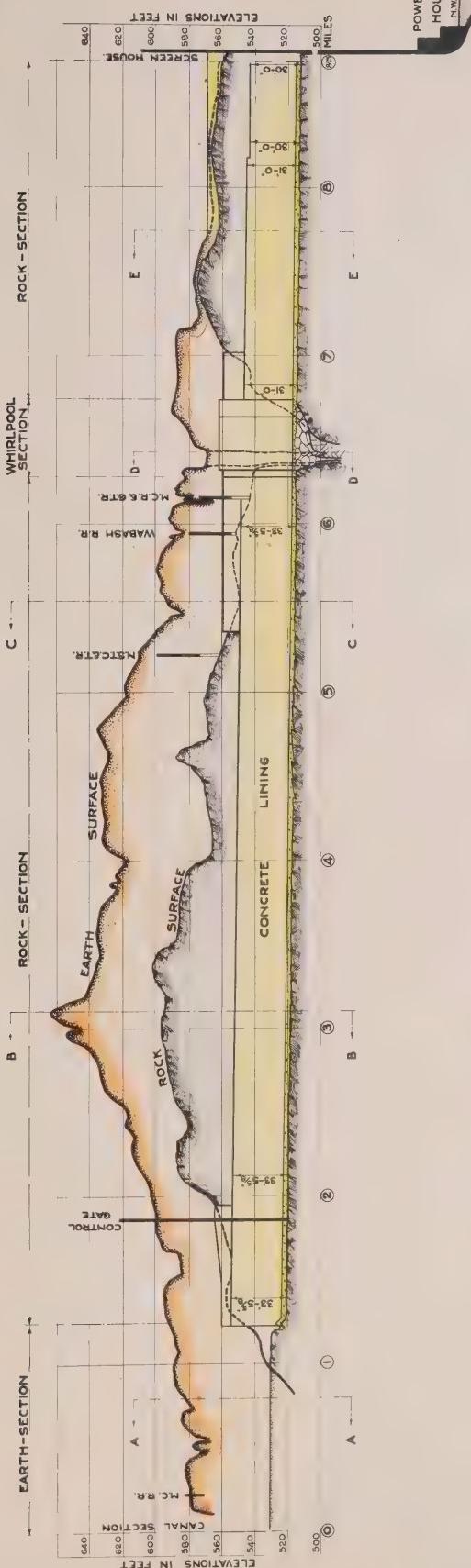
Earth Section.

## C O P Y

The earth section of the Canal commences at Station 0+00 on the Welland River and ends at the commencement of the concrete-lined rock section at Station 64+00, having a total length of 6,400 feet. As shown in "Section A1" of the drawing referred to above, included as page B-20, excavation has been carried out to provide a minimum width of 150 feet at the bottom of the Canal, and to a depth of 20 feet below the surface of the water. The side slopes are made at an angle of two horizontal to one vertical. The excavation was carried down to Elevation 530.0 at the southerly end, and 529.22 at the northerly, with a slope of 0.000119, or 0.63 feet per mile, between these two points. The average depth of cut is about 50 feet. The ground through which the earth section has been excavated may be described as being composed generally of blue clay.

The designs contemplate a bottom width of 240 feet through the earth section of the Canal when ultimately completed, that is, for a flow of 15,000 cubic





(E-20)

**HYDRO-ELECTRIC INQUIRY COMMISSION**

W.D.GREGORY = CHAIRMAN

Scalbar & indicated

Scans As indicated  
Toronto, May 19<sup>th</sup> 1922      Made by *CW&D* Checked by *W.J.F.*  
**WALTER J. FRANCIS, C.E.,**

Cet article

Toronto May 19<sup>th</sup>. 1922      Made by C.M.D. Checked by W.J.F.  
WALTER J. FRANCIS, C.E.,

CONCRETE SHOWN THUS:-

ROCK SHOWN THUS:-

EARTH SHOWN | HUGS



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(B-31)

feet per second or more.

Southerly Rock Section.

The southerly rock section extends from Station 64+00 to Station 529+50, a total distance of 26,550 feet. For practically the entire length of this section the surface of the rock was considerably above the elevation determined for the water level of the Canal, and everywhere there was a deep overburden. The maximum depth of the cut is 140 feet below the ground surface and occurs in the vicinity of Lundy's Lane. The maximum depth of rock excavation was found to be 83 feet. The excavation was carried down to Elevation 522.3 at the southerly end and 516.74 at the northerly, with a slope of 0.0002113, or 1.11 feet per mile, between these two points.

Photograph B-6 indicates the character of the rock, while photograph B-7 shows the rock and the overburden in detail during construction. These pictures are included herewith as page B-22.

The bottom of the Canal was paved and the sides were lined throughout the rock section with concrete, smoothly finished, as will be seen by reference to the photograph on page B-23. The width of the rock cut on the straight portions was uniformly 50 feet, while the clear finished width from face to face of the concrete lining is 48 feet. In the curves of the Canal additional width was obtained by using a constant radius of 500 feet for the finished concrete surface on each side of the Canal. Channellers were used on both sides of the cut, working down from the surface a depth of ten feet or thereabouts. The design provides that the earth overlying the rock be excavated to a width sufficient

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To face page E-32

No. E-6

Photograph showing

Character of Rock walls of Canal, ready for Sealing,

looking along bottom of Canal.

Taken June 1st, 1920

**C O P Y**

No. E-7

Photograph showing

Rock-work of Canal, and overburden,

looking from top of cut.

Taken May 4th, 1921





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To face page E-25

No. E-8

Photograph showing  
Canal with finished corporate lining.  
**COPY**  
looking along bottom.

Taken December 22nd, 1921.





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(E-24)

to allow a berm of 10 feet on each side of the Canal between the toe of the earth slope and the edge of the rock cut, and then sloped back on each side with slopes of one and one-quarter horizontal to one vertical, covered with riprap, with a slope of one and three-eighths horizontal to one vertical. The material overlying the rock throughout this section was found to consist of sand in the northerly half, and blue clay in the southerly part, with coarse gravel and sand immediately over the rock throughout the whole length. The rock itself is Niagara limestone of varying degrees of hardness, in many places broken up by numerous seams, but generally uniform in stratification.

## COPY

### Whirlpool Section.

At Bowman's Gully, opposite the Whirlpool, the natural surface of the ground dropped below the elevation of the bottom of the Canal, and the surface of the rock proved to be entirely beyond the reach of rock drills. The engineers of the Hydro-Electric Power Commission decided to fill the gully with rock spoil, and to construct the Canal in embankment.

The Whirlpool Section commences at Station 332+50, and ends at Station 348+55, thus having a length of 1,605 feet. At the south end there is a "transition" connecting the Rock Section and the Whirlpool Section, and occupying a length of 300 feet. Similarly, at the north end of the Whirlpool Section there is another "transition" from Station 348+55 to Station 354+00, a total length of 545 feet. The object of these transitions is to provide a gradual change from the square section to the trapezoidal section and vice versa, with minimum disturbance to the natural flow of the water in the Canal.

(1942)

with the very same students, which has taken place since 1936. It followed a series of state trials in which university students from other states and the centre had been sent to various cities throughout India to give evidence against them. And this resulted in the formation of the "Students' Council of Dissident Universities" which gave birth to the "National Students' Conference" in 1937. This conference is described as having been convened by the students of the various universities to decide upon their common cause of action and to frame a definite programme. After this conference all the universities of India, except one or two, had agreed to join this organisation. They had been quite different since the beginning, some of them being for certain policies, the central council consisting of twenty-four universities of certain provinces and others comprising of the central councils

## COPY

RECORDED AND INDEXED

and the others, such as Bihar and Assam, were extremely right-winged. But the central council was the only body that had to make up the national and nationalised University League. And this body gave the former two groups recognition and so became known as the "central council". With the formation of this body, the former two groups, namely, the centralised and the uncentralised universities, had joined together to form the central council. The central council, which had been formed in 1937, had a large number of members and the "central council" had adopted a general policy. According to this general policy, the central council had to keep its members in touch with each other, and to keep them in touch with the government, which had to be organised in such a manner that it can be easily understood by the students. In addition to this, the central council had to maintain a certain kind of discipline among its members, so as to maintain peace and order. And this had to be done by means of strict rules and regulations and by making friends with such organisations, which had a good record and a good name. In addition to this, the central council had to maintain a certain kind of discipline among its members, so as to maintain peace and order. And this had to be done by means of strict rules and regulations and by making friends with such organisations, which had a good record and a good name.

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(E-25)

The general layout of the Whirlpool Section and "Transitions" is clearly shown on the aeroplane photograph included herewith as page E-26.

As shown in the diagram on page E-20, the cross-section of the Canal in the Whirlpool Section is 10 feet wide at the bottom, with side slopes of one and one-half horizontal to one vertical, and the Canal is built on a heavy consolidated rock fill having exterior side slopes of one horizontal to one vertical, the depth of the fill varying with the elevation of the natural ground surface to a maximum of about 100 feet. The bottom of the Canal is at Elevation 516.74 at the southerly end of the southerly transition, and 516.20 at the northerly end of the northerly transition with a uniform slope of 0.0002113, or 1.11 feet per mile, between these two points. The manner in which the embankment was prepared is shown in the two photographs included herewith as page E-27. Spoil from the Canal was deposited on either side of the rock fill with the object of increasing the stability of the fill, and also of disposing of the surplus material from the Canal, and of evening up the surface of the ground between the Canal and the Whirlpool.

The Whirlpool Section is lined with concrete throughout, with a minimum thickness of twelve inches. In order to avoid the possibility of the concrete being broken by back-pressure of water contained in the fill, in the event of the water being drained from the Canal, weep-holes are provided both near the top and near the bottom of the concrete lining. The finished work from Rock Section to Rock Section is clearly shown on the photograph included herewith as page E-28.



W. G. LEAF & CO., PUBLISHERS OF THE COUNCILMAN.

MR. J. A. VILAN ROSE.

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To face page B-26.

No. B-9

**COPY**  
Photograph showing  
Whirlpool Section and "Transitions",  
looking northerly from aeroplane.

Taken September 23rd, 1921.





MARTELS T. FERNAND G. COMPRINA

CASA SOR BRIGIDINE DE M.º Q. M.º JESUS GOMES

COPIA

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To face page E-27

No. E-10

Photograph showing  
Surfacing of Rock Fill in Shallow section  
forming foundation for concrete lining.

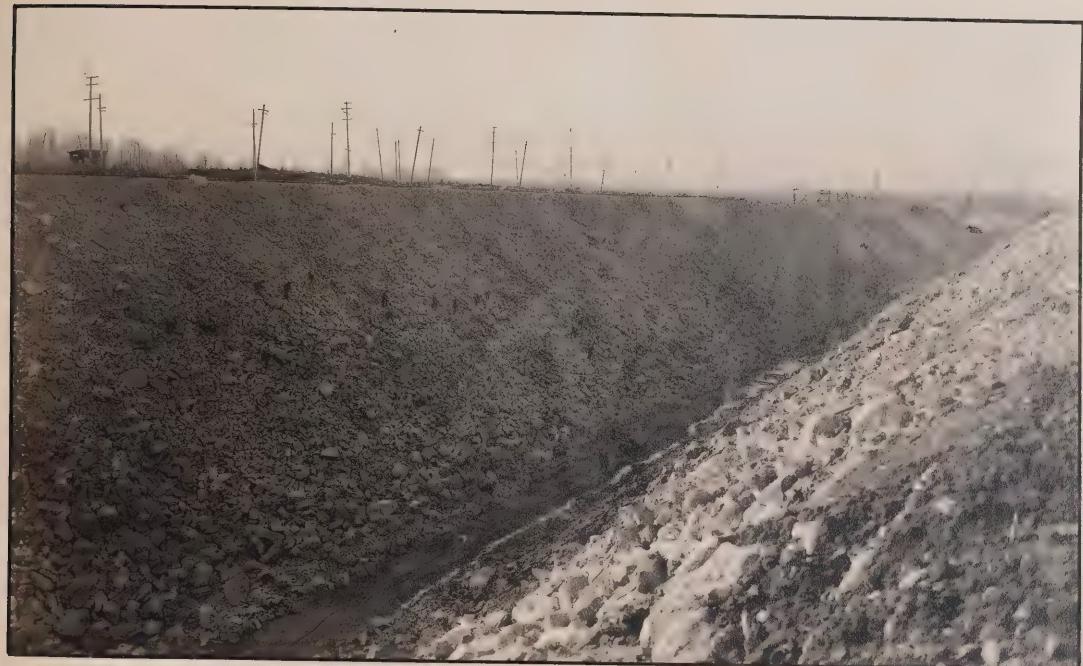
Taken January 8th, 1921

C O P Y

No. E-11

Photograph showing  
Surfacing of rock fill in Shallow section  
forming foundation for concrete lining.

Taken March 4th, 1921.





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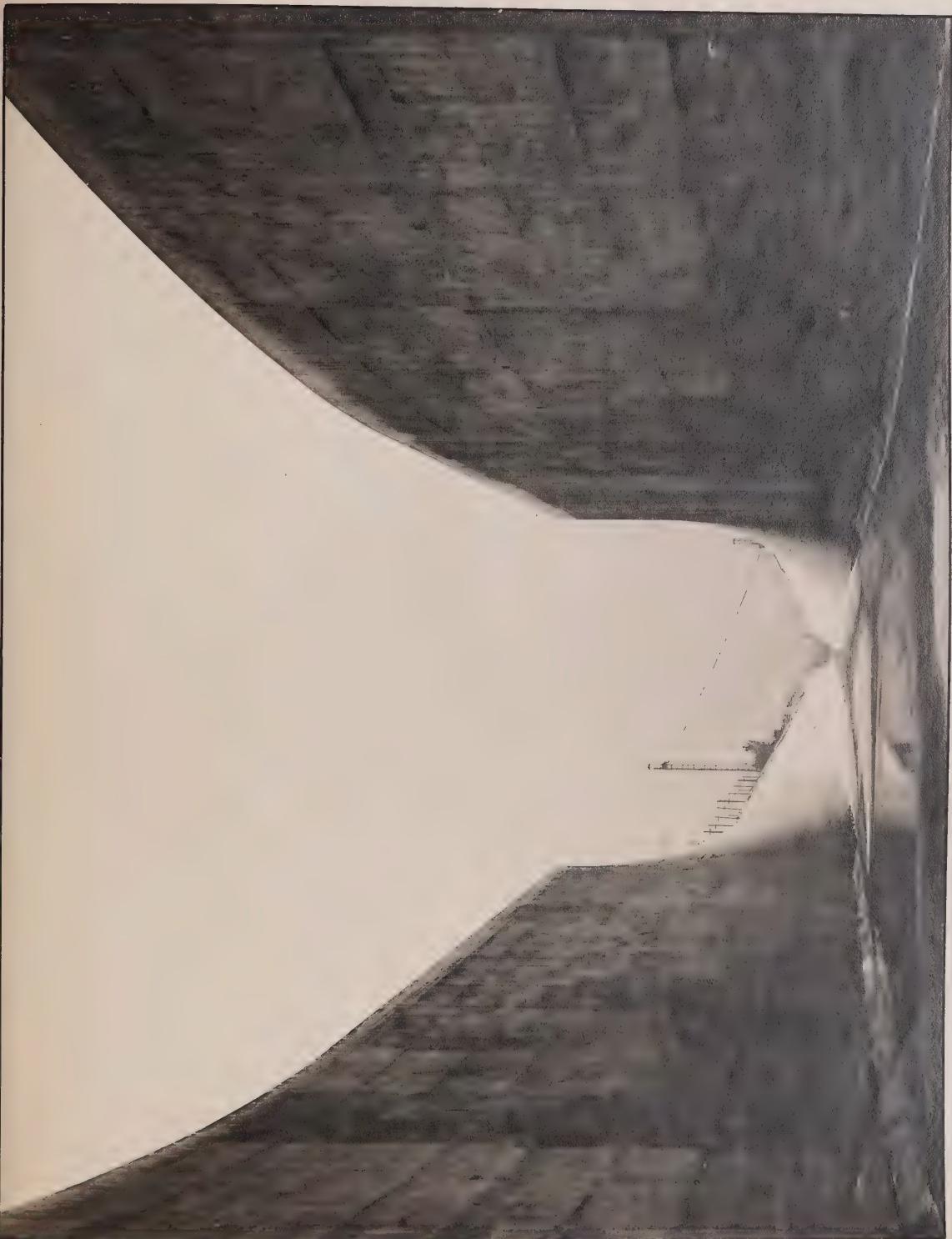
COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page B-26.

No. B-12

Photograph showing  
Coriolated Whitroot Section and "Transitions".  
COPY  
looking north-easterly from the bottom.

Taken December 25th, 1921.





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(E-29)

Northerly Rock Section.

The Northerly Rock Section commences at the northerly end of the Whirlpool Section transition at Station 554+00, and continues to the beginning of the Purchay at Station 462+84, having a total length of 9,884 feet. This Section is similar to the Southerly Rock Section with the exception that the depth of the overburden was very much less. The excavation was carried down to Elevation 514.20 at the southerly end, and 514.15 at the northerly, with a uniform slope of 0.0002113, or 1.11 feet per mile, between these two points.

The Control Gate.

**C O P Y**

For the purpose of regulating or of cutting off the flow of water in the Canal, a control gate of the "Stoney Sluice" type has been erected at the entrance to the Southerly Rock Section at Station 97+00. The clear span of the gate is 48 feet, and the height from sill to top is 42.6 feet, while the total lift is 54.6 feet.

The movable portion of the gate is a steel structure plated on the southerly side, riveted and caulked. The gate slides against rollers in vertical grooves set into the concrete on either side of the Canal, and is supported by heavy steel chains with counterweights, the chains passing over drums carried on a steel superstructure. An electric motor is provided for the purpose of raising or lowering the gate.

The details of the gate and of the supporting structure are shown in the photograph included herewith as page E-30.

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To face page E-50

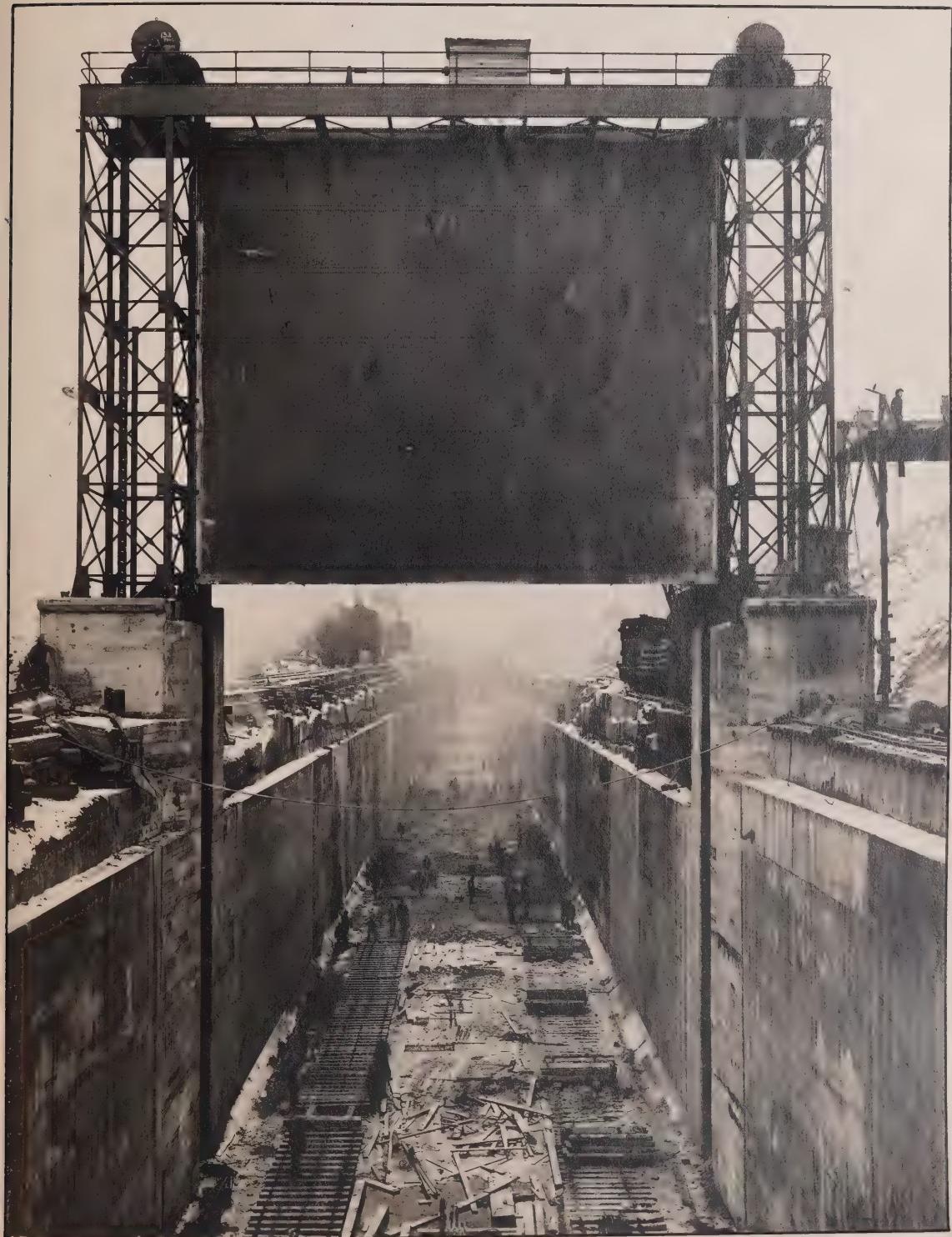
No. E-15

Photograph showing  
**COPY**

Canal Control Gate at South End of Rock Section.

looking northerly from rock level.

Taken December 22nd, 1921.





The Forebay.

The purpose of the Forebay is to provide a means of uniformly distributing the water from the Canal to the various penstocks at the Screen House, which are spread over a width of about 500 feet. The change in the flow of the water from the Canal to the Screen House has to be made in such a way as to avoid abrupt alteration in the velocity in order to decrease the loss of head which would otherwise occur. This result is obtained by gradually widening the Canal from a width of 48 feet to a width of about 500 feet at a uniform rate in a length of about 900 feet, thus forming what is referred to as the "Forebay".

**C O P Y**

As the surface of the rock at the site of the Forebay carried very little overburden and was generally below the elevation of high water, the concrete side-walls were built with the top at Elevation 570.0, about 6 feet above the maximum ordinary water level in the Forebay.

The Forebay was excavated down to about Elevation 514.0, thus providing a depth of water of about thirty feet when the plant is running at full capacity.

It can be readily understood that the water from the Canal passing into the Forebay at high velocity would tend to impinge upon the centre of the Screen House instead of being uniformly distributed to all the openings therein. In order to avoid this undesirable effect a "diffuser" has been constructed of reinforced concrete at the entrance to the Forebay, dividing the water into two channels, ensuring a more uniform velocity throughout the width of the Forebay. The diffuser has a length of 221 feet and gradually widens from a sharp prow at the upstream end to a width of 37 feet at the other.

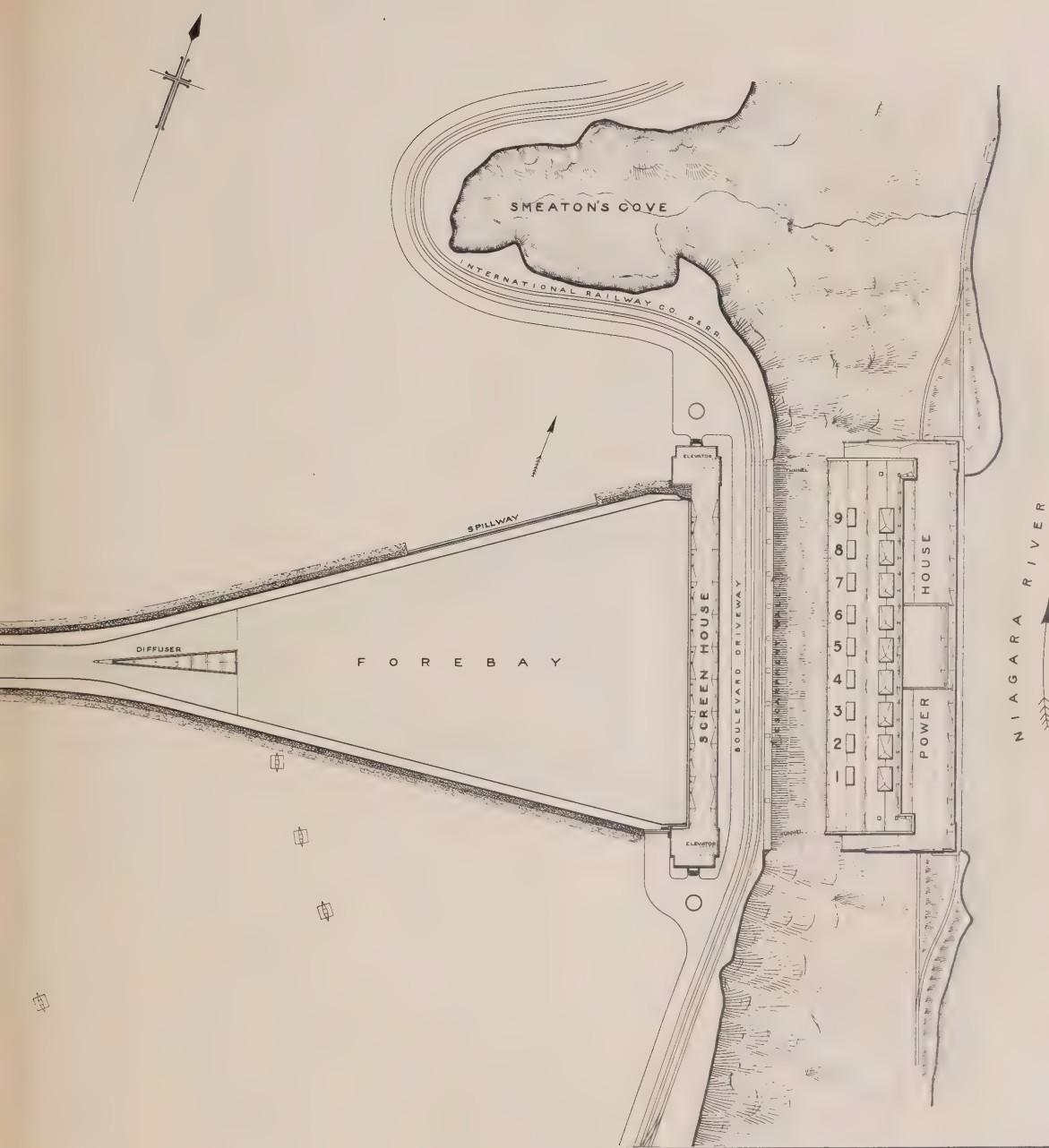
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and much information about the people and events over the preceding week. Information can be gathered from news media, social media, and word-of-mouth. The best way to do this is to have a team of people who are experts in their field and can quickly assess what is important. This will help to ensure that the information is accurate and timely. It is also important to keep an eye on emerging trends and developments, as well as changes in the political landscape. This will allow for a more informed and effective response to any challenges or opportunities that may arise.

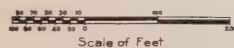
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Answers - part 1 answer sheet and the notes and the slides and the answers and all  
answers will probably need to be printed off and written over and then uploaded  
and made into a word document so you can make easier some calculations  
available and it looks good qualities etc.



## PLAN OF PROPOSED FINAL DEVELOPMENT



HYDRO-ELECTRIC INQUIRY COMMISSION  
W. D. GREGORY - CHAIRMAN  
QUEENSTON-CHIPPAWA POWER DEVELOPMENT  
**PLAN OF FOREBAY, SCREEN HOUSE  
AND POWER HOUSE**

Scale as Indicated  
Toronto, May 16<sup>th</sup> 1922 Made by HPA Checked by *[Signature]*

WALTER J. FRANCIS, C.E.  
CONSULTING ENGINEER



MR. J. ALLEN ROSS  
C. O. BUNDY & CO.

WALTER J. FRANCIS & COMPANY.  
COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page N-58.

No. 2-14

Photograph showing  
~~COPY~~

Forsay Excavation with reference to Canal,  
Acres House and Power House,  
looking westerly from aeroplane.

Taken September 23rd, 1921.





COPY

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To face page B-34

No. B-15

Photograph showing  
Completed Diffuser at Farshay,  
looking along Rock Section.

Taken December 8th, 1921.

C O P Y

No. B-16

Photograph showing  
Completed Diffuser at Farshay,  
looking towards Screen House,  
(about 15 feet of water in Canal.)

Taken December 25th, 1921.





BOOK MARKS & STATIONERY AND BOOKS



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To face page E-35.

No. E-17

Photograph showing  
**COPY**  
Detail View of completed Diffuser,  
looking towards Screen House.

Taken September 1st, 1921.





*Collage* *versus* *real life*

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To face page E-36.

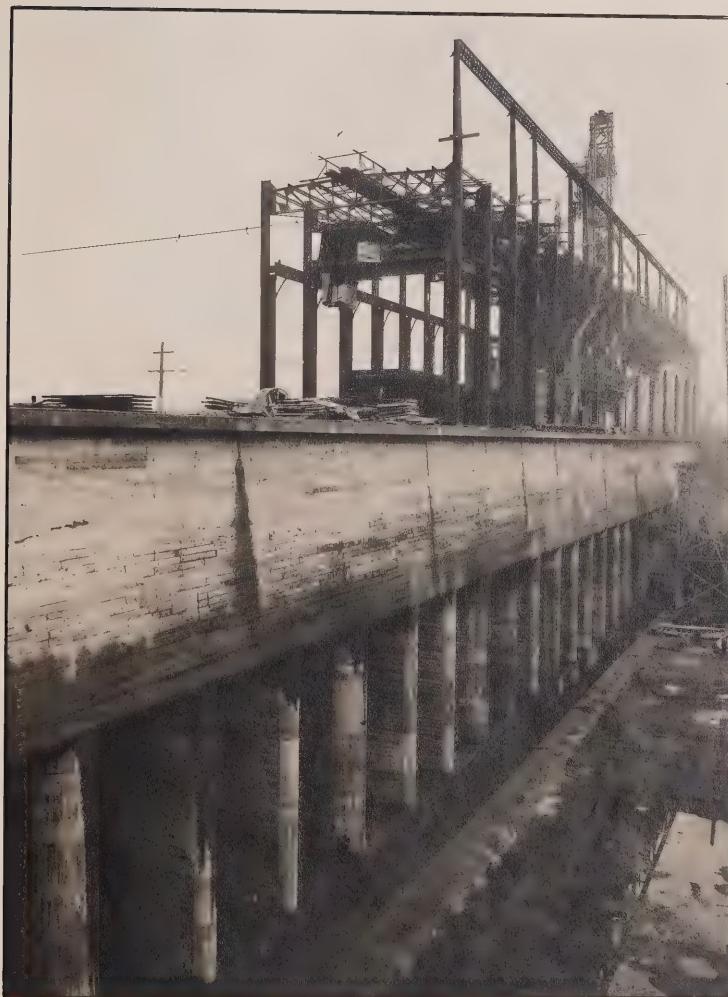
No. E-18

Photograph showing  
**COPY**

Breast-Wall of Screen House and Entrance to Draft Tube,

looking south-easterly.

Taken November 17th, 1921.





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(E-37)

The top of the diffuser is at Elevation 542.0 so as to be constantly submerged. An aperture in the end wall admits water to the interior and assures approximately equal water pressures on both sides of the walls.

The plan entitled "Plan of Forebay, Screen House and Power House", included herewith as page E-32, shows the location of the Forebay and the diffuser with regard to the adjacent Screen House and Power House. The photographs also included herewith as pages E-33 to E-36, show the salient features of the Forebay.

**COPY**  
The Screen House.

The general location of the Screen House may be seen on the plan on page E-32.

The concrete substructure of the Screen House is 500 feet long by 56 feet wide, founded in the solid rock which was excavated to Elevation 512.0 for the purpose. The top of the substructure is at Elevation 568.0. The clear distance between the substructure and the general line of the cliff is about 60 feet. The excavation work is clearly shown in the photographs on page E-36, while the substructure itself is shown in the photograph on page E-39.

The substructure primarily provides the means of admitting water from the Forebay to the Penstocks, of which there will be ultimately ten in all, one service penstock and nine main unit penstocks, placed in order commencing after the ice chute at the southerly end of the structure.

The ice chute entrance is 25 feet wide, with the upstream sill at Elevation

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To face page E-58.

No. E-19

Photograph showing  
Excavation for Screen House and Penitack Tunnels.  
looking south-easterly.

Taken January 8th, 1921.

C O P Y

No. E-20

Photograph showing  
Excavation for Screen House Foundation.  
looking northerly.

Taken March 4th, 1921.





MANASO SAGAR

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To face page 2-39.

No. E-21

**Photograph showing**  
**COPY**  
Forest House Substructure.

looking southerly.

Taken September 1st, 1921.





535.0, and is controlled by two sets of gates.

The service penstock entrance is 12 ft. 8 ins. wide, with the sill at Elevation 514.167, eventually leading to the mouth of the penstock which is 5 ft. 6 ins. in diameter. The entrance is sealed by a curtain wall and is controlled by a gate about 13 feet from the upstream face of the wall. Back of the gate, 6 feet therefrom at the bottom and 10 ft. 5 ins. therefrom at the top, is a screen to prevent the admission of debris.

The nine main unit penstocks are located uniformly 50 feet apart, centre to centre. Every unit has three entrances 12 ft. 8 ins. wide, with the sills in all cases at Elevation 514.167. **COPY** The elevation of the lower face of the curtain wall sealing the opening is Elevation 542.07, which gives a depth of water of 28 feet. The main piers between the units are 6 foot wide, while the secondary piers in the tripartite entrances are 3 feet in width, as may be seen by reference to the photograph on page E-36. The details are shown more clearly on photograph No. E-22, included herewith as page E-41, while the lower picture, No. E-23, on the same page, shows how the concrete bell-mouth was formed so as to lead the water smoothly from the tripartite entrance to the circular penstock tube. Every opening is controlled by a gate and protected by a screen as in the case of the service entrance.

The substructure is surmounted by a superstructure of steel and concrete, housing and protecting the machinery for operating the gates and handling the screens. The southerly end of the superstructure may be seen in the photograph on page E-36. The steel frame-work of the superstructure is extended above the roof to form one of the first of the transmission towers.

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To face page E-41.

No. E-22

Photograph showing  
Detail of Junction of North End of Screen House Breast-Wall  
with Rock Side of Forebay,  
looking northerly.

Taken November 17th, 1921.

C O P Y

No. E-23

Photograph showing  
Detail of Part of a Penstock Bell-Mouth Entrance at Screen House,  
looking towards Penstock.

Taken July 22nd, 1921.





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(B-42)

At the southerly end of the Screen House is located the administration building for the Power House, connected therewith by an elevator operating in a shaft which is joined with the plant by a tunnel, both shaft and tunnel being excavated in the solid rock. The construction of a similarly equipped building is contemplated at the northerly end of the Screen House.

The space between the Screen House and the escarpment will be finished to provide accommodation for vehicular traffic, electric railway traffic and pedestrians. A sidewalk twelve feet wide, protected by a railing, will have its outer edge 105 feet from the centre of the Screen House, thus projecting somewhat beyond the edge of the cliff. Next to the sidewalk there will be two electric railway tracks, and between the tracks and the Screen House a finished roadway 22 feet wide.

#### The Penstocks.

There are ten penstocks provided for in the ultimate development, in addition to the ice chute. The ice chute is at the southerly end of the series. Next to it and 24 ft. 10 ins. therefrom, measured centre to centre, is the service penstock. Following in order are the main unit penstocks, 50 feet centre to centre, No. 1 main unit penstock, the most southerly one, being 34 ft. 4 ins., centre to centre, from the service penstock. The ice chute is formed in reinforced concrete with an internal diameter of 10 feet. For the main units the penstock is of riveted steel plate encased in concrete, and it leads from the concrete lined tunnel connecting with the downstream side of

SUNDAY

celebrations and festivals in India began with the first sunrise and the last sunset and the greatest events in life like birth marriage death and other milestones. Today we finally have a yearning for simplicity and purity which is reflected in the traditional values of our forefathers with purity being one of the greatest values. We are now living with the modernities of technology and science but still hold onto our traditional values. Although technology has advanced rapidly, it does not change the basic principles of our culture. It is important to understand that technology should be used to enhance and work towards our goals rather than become an obstacle to them. **1900** is a year with strong influences of modernity and also reflects the ancient values of our culture.

*With love & respect to all my dear friends*

## REFERENCES

All references cited above are from my library, collection, and the available resources on the web. I have not done any research and this article has just for informative purposes. All sources of original information are mentioned under the reference section. I do not claim ownership of any material cited, unless otherwise indicated, those will remain the property of their original author or source. I do not claim ownership of any material used here without the express written permission of its owner, which is usually the author or source. All the materials contained on this website are copyrighted and protected by law. No part of this website may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the author.

the Screen House through tunnel excavation in the rock to the edge of the escarpment. Curving down with a bend over the escarpment in a trench excavated in the rock, on a slope of about 60 degrees with the horizontal, the penstock has a second bend at the level of the centre of the turbine, and is finally joined by a short horizontal portion to a Johnson valve adjacent to the turbine. The horizontal distance from the centre line of the Screen House to the axis of the main units is 350 ft. 6 ins., while the vertical distance from the centre of the upper part of the penstock to the centre of the lower part is 234 feet. The diameter of the upper two-thirds of the length of the main unit penstocks is 16 feet, which is reduced by means of a taper section to 14 feet for the balance of the length. The thickness of the plating varies from one-half inch at the top section to one and one-quarter inches at the lowest section. All joints are made with butt straps, thus producing a smooth interior excepting for the longitudinal butt straps and the rivet heads. Water-tightness is obtained by caulking the longitudinal seams, and welding the circumferential, always working from the inside. The bend near the upper end, as well as that near the lower, is anchored in a mass of concrete. The minimum thickness of the concrete encasing the remainder of the pipe is 2 feet.

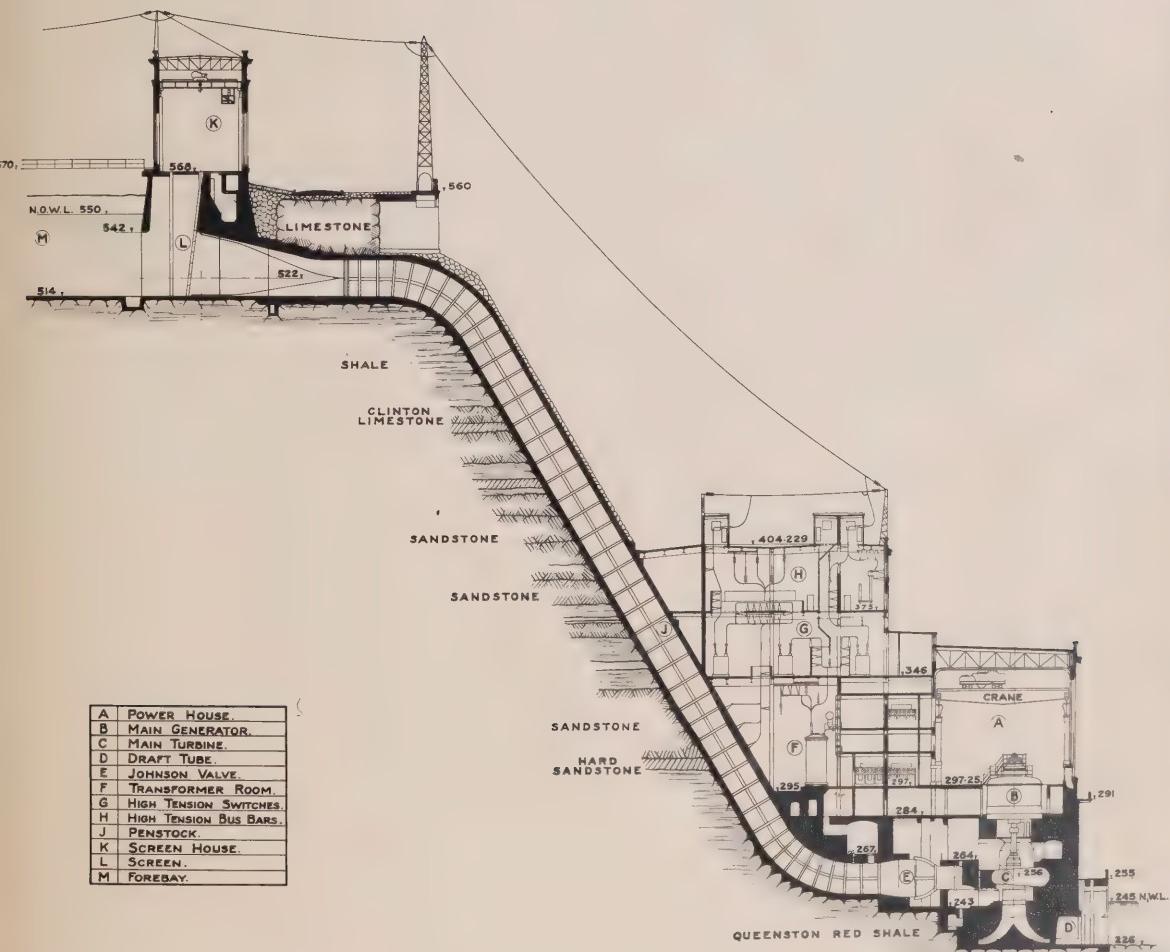
The large Johnson valve referred to above, has an outlet 10 feet in diameter, and connects to the turbine casing by a number of sections of flanged cylindrical steel castings. A hand lever on a three-way plug valve controls a number of pistons under penstock pressure, and they in turn control three eight-inch Johnson valves which actuate the large valve.

The penstock of the service units follows the same alignment as those for

1703

2. The following table summarizes the results of the study.

and the author's name and address, and a short summary of the article.



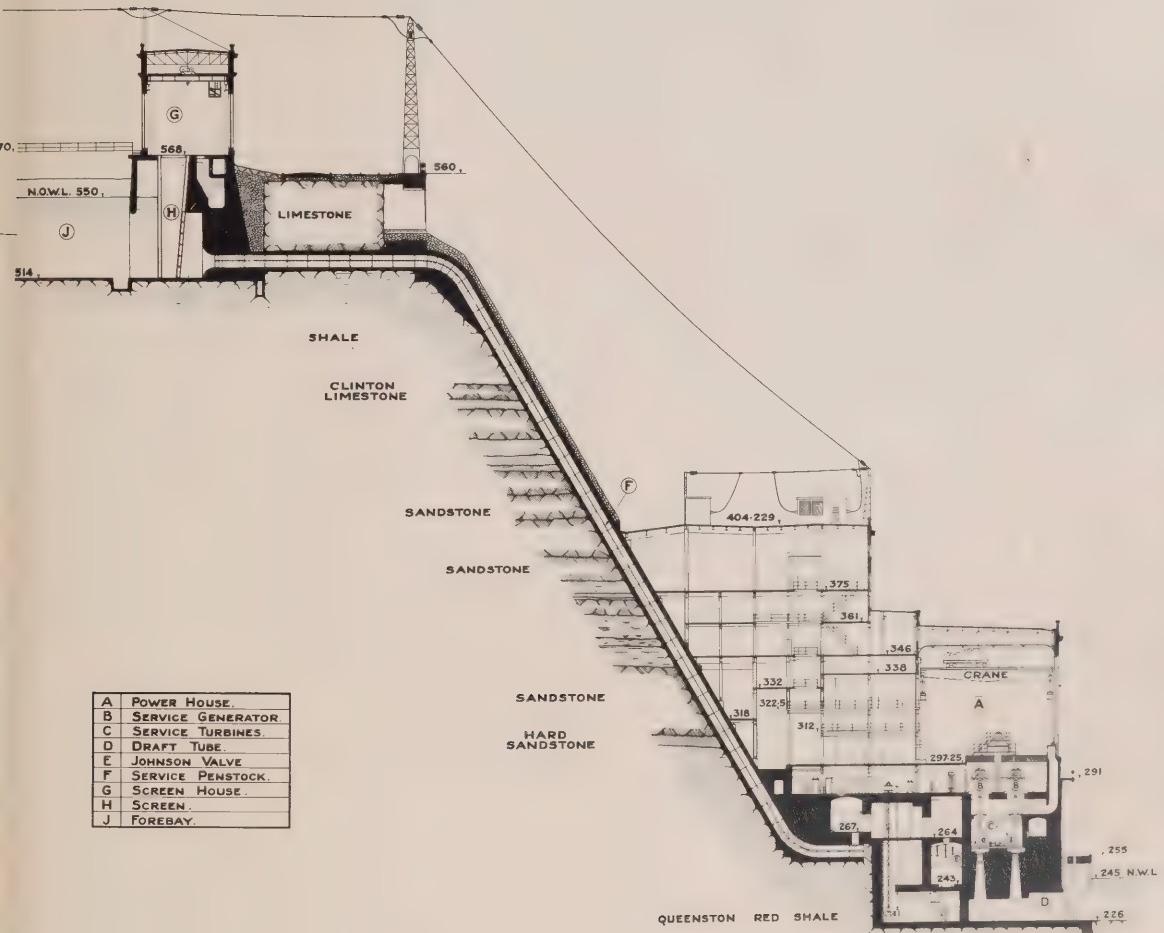
A	POWER HOUSE.
B	MAIN GENERATOR.
C	MAIN TURBINE.
D	DRAFT TUBE.
E	JOHNSON VALVE.
F	TRANSFORMER ROOM.
G	HIGH TENSION SWITCHES.
H	HIGH TENSION BUS BARS.
J	PENSTOCK.
K	SCREEN HOUSE.
L	SCREEN.
M	FOREBAY.

ELEVATIONS REFERRED TO H.E.P.C. DATUM SHOWN THUS:- 291

Scale of Feet

HYDRO-ELECTRIC INQUIRY COMMISSION.  
W. D. GREGORY — CHAIRMAN.  
QUEENSTON-CHIPPAWA POWER DEVELOPMENT.  
**SECTION THROUGH SCREEN HOUSE,  
MAIN PENSTOCK AND POWER HOUSE**  
Scale as Indicated  
Toronto, May 25<sup>th</sup> 1922 Made by H.P.A. Checked by J.D.  
WALTER J. FRANCIS, C.E.,  
CONSULTING ENGINEER.





ELEVATIONS REFERRED TO H.E.P.C. DATUM SHOWN THUS:- 1291

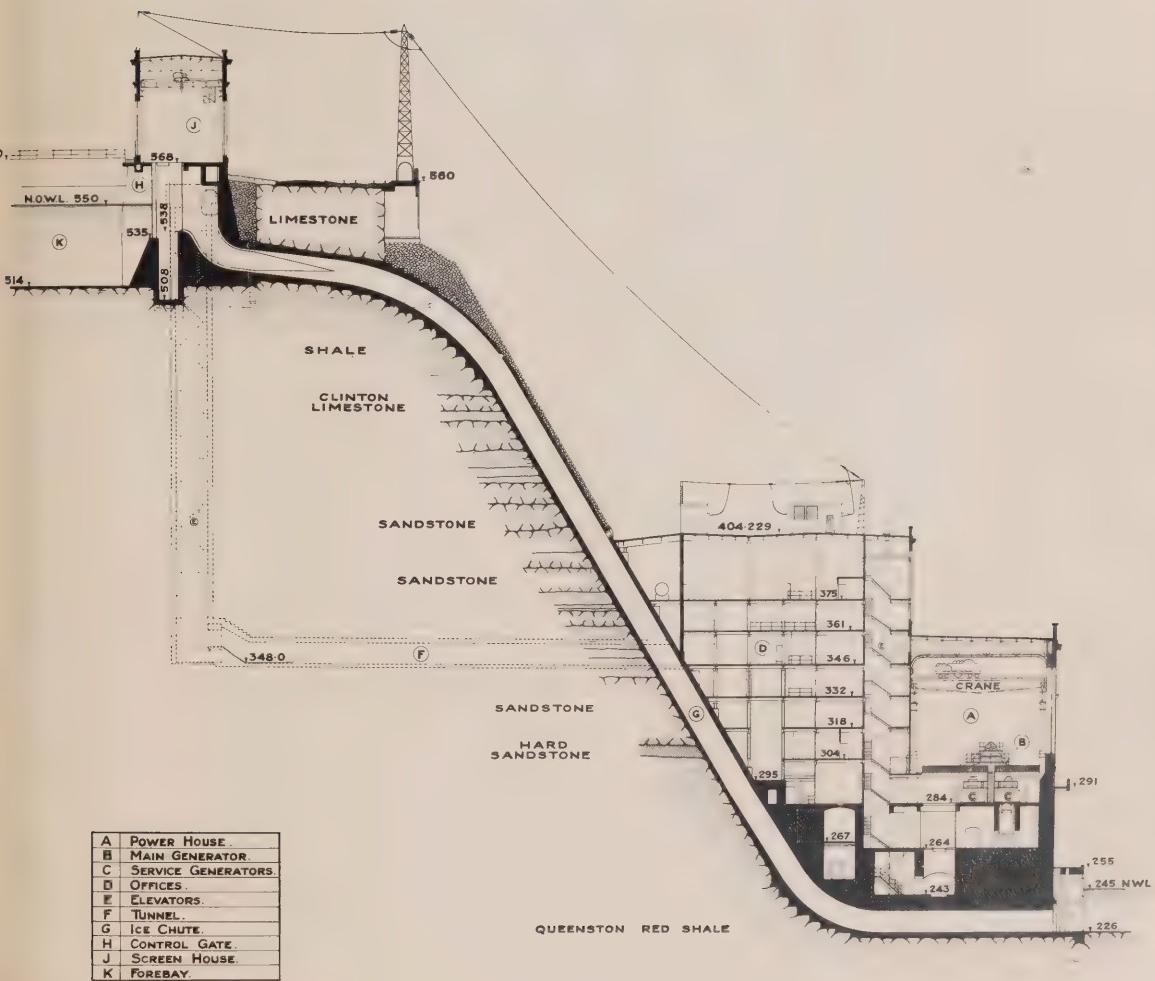
Scale as Indicated

Toronto, June 7th, 1922   Made by H.P.A. Checked by *[Signature]*

**WALTER J. FRANCIS, C.E.**  
CONSULTING ENGINEER

Scale of Feet





ELEVATIONS REFERRED TO H.E.P.C. DATUM SHOWN THUS:- 1291

Scale of Feet.

Hydro-Electric Inquiry Commission  
W. D. GREGORY - CHAIRMAN  
QUEENSTON-CHIPPWA POWER DEVELOPMENT  
SECTION THROUGH SCREEN HOUSE  
ICE CHUTE AND POWER HOUSE  
Scale as Indicated  
Toronto, June 15<sup>th</sup> 1922. Made by H.P.A. Checked by *[Signature]*  
WALTER J. FRANCIS, C.E.  
CONSULTING ENGINEER

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-46.

No. E-24

Photograph showing  
Construction of Ice Climate and Service Penstocks.

looking from roof of Power House.

Taken January 6th, 1922.





## ANSWER

... *littera* *curia* *rebus* *ad*

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page 2-49.

No. X-25

Photograph showing  
Construction of main Damstocks.  
**COPY**  
looking from roof of Power House.

Taken January 6th, 1922.







WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-60.

No. E-27

Photograph showing  
Johnson Valve at Lower End of Main Penstock,  
looking from Penstock.

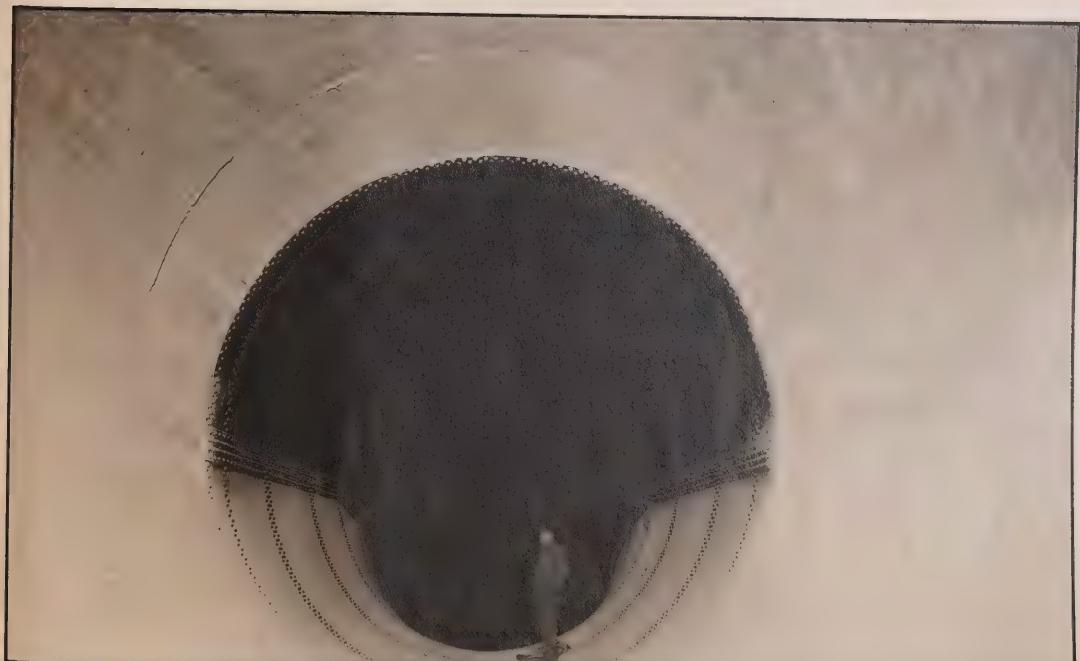
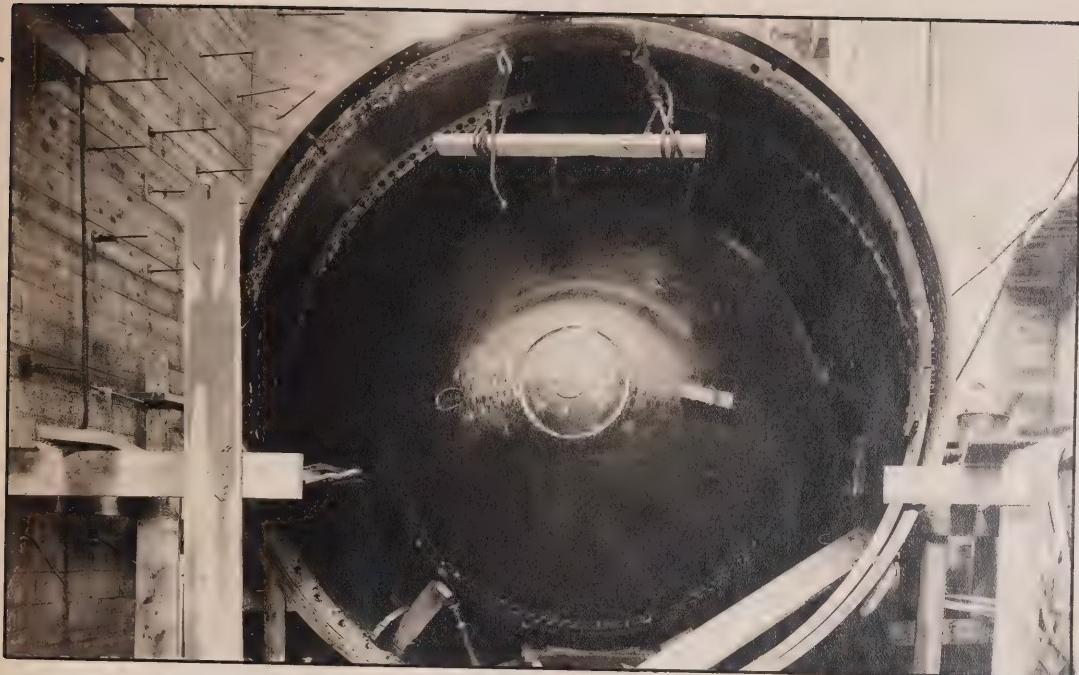
Taken February 4th, 1922.

**COPY**

No. E-26

Photograph showing  
Upper End of Main Penstock,  
looking into Penstock.

Taken April 7th, 1922.





WALTER T. FRANCIS & COMPANY

COPY FOR CONFERENCE TO MR.

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page II-51.

No. 2-28

Photograph show  
**COPY**

Lower End of Main Channel and River of Johnson Valley.

looking towards south.

Taken June 19th, 11.





MAPLES & BROWN & CO (CONTINUED)

DRUGS FOR EXTERNAL USE MR. J. VITIAN BOSS

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-62.

No. E-20

Photograph showing

Pennstock Excavation and Character of Rock at Summit of Escarpment.

looking from roof of Power House.

Taken April 21st, 1922.





WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLEN ROSS.

(E-55)

The Power House.

The Building.

The Power House, located at the water's edge of the Niagara River, directly opposite and parallel to the Screen House, is about 680 feet in length. The site is shown on photograph No. E-50, included herewith as page E-54, the picture indicating the conditions just after the commencement of the excavation. It consists essentially of a substructure and a superstructure. The substructure, which is primarily the containing structure of the main units, has its top surface at Elevation 297.25, while the bottom is founded in the solid rock which has been excavated down to about Elevation 224 for that purpose. At the present time the Power House will be completed from the southerly end far enough to contain main unit No. 5, the units being numbered in order from south to north, a length of about 540 feet. Within the portion now under construction are contained the two service units, five main units and the auxiliary plant, as well as the necessary electrical connecting parts.

The settings of the five main units are substantially alike, except that the draft tube of No. 1 is of the usual curved type, somewhat modified, while those for units Nos. 2, 3, 4 and 5 are of the Moody spreading type. The framework for draft tube No. 1 is shown on the upper photograph, No. E-51, on page E-55, while the lower photograph, No. E-52, on the same page shows the finished concrete work thereof. The Moody draft tube for the other main units is well illustrated in the next three photographs, the first of which, No. E-55,

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Copy for Enclosure to Mr. T. A. LEE

RECORDED

WALTER J. FRANCIS & COMPANY

COPY FOR ENCLOSURE TO MR. J. ALIAN ROSS.

To face page E-54.

No. E-50

Photograph showing  
**COPY**  
Power House Site at commencement of Excavation,  
looking north-westerly.

Taken December 7th, 1919.





1792

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page 2-55.

No. 2-31

Photograph showing  
Formwork for Draft Tube No. 1.  
looking southerly.

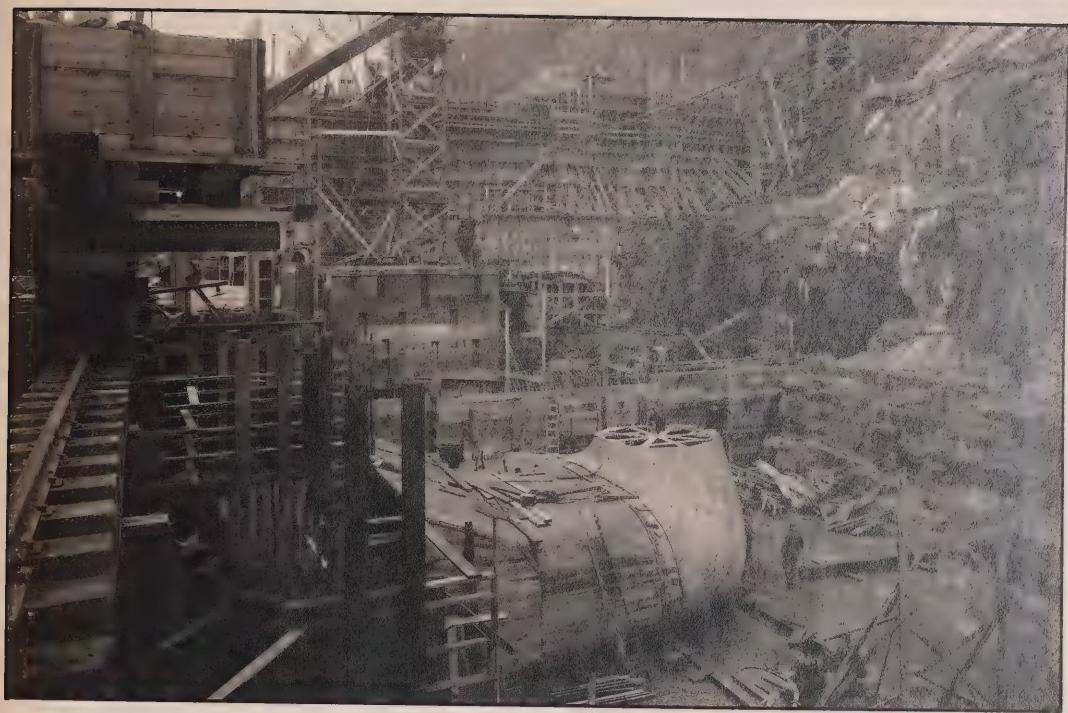
Taken December 12th, 1920.

C O P Y

No. 2-32

Photograph showing  
Interior of Draft Tube No. 1.  
after removal of forms.

Taken March 22nd, 1921.





Mr. J. A. Tamm, Esq.,  
of the firm of Tamm & Co.,  
and Mr. J. A. Tamm, Esq.

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-56.

No. E-55

Photograph showing  
Formwork for "Moody" Draft Tube No. 2.  
looking westerly.

Taken February 1st, 1931.

**C O P Y**

No. E-54

Photograph showing  
Gone for "Moody" Draft Tube No. 2.  
after removal of forms.

Taken July 8th, 1931.







WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-57.

No. E-36

Photograph showing  
**COPY**

Completed Side Passage of "Moody" Draft Tube No. E.

looking towards rear.

Taken December 7th, 1921.





on page E-56, shows the finished formwork; the second, No. E-34, on the same page, a detail of the draft tube cone; while the third, No. E-55, on page E-57, gives a detail view of the finished concrete of one of the side passages.

The substructure forms the anchorage at the bottom of all the penstocks, and is also arranged as the foundation of all the turbines and the electrical machines, and to provide access thereto by archways, tunnels and passages. Briefly, there are five principal levels in the substructure: Elevation 226, the floor of the tail race; Elevation 245, giving access to the under side of the main turbines; Elevation 264, giving access to the gate mechanism of the main turbines; Elevation 284, below the base of the service units and of the main units; and Elevation 297.25, the main operating floor, or top of the substructure, on which are also located the low tension switching apparatus and the high tension transformers. Along the river side, the substructure extends in the form of piers arched over with a floor, the top of which is at Elevation 255, constituting a railway passage, and in the southerly end is a large doorway with the sill at Elevation 264 whereby the railway cars may be taken into the Power House. In addition to the principal features, many details such as drainage, filtration, assembly and repairs have been provided for. The substructure is of concrete throughout, reinforced with steel where special stresses occur. With the exception of the end doorway, which is provided with stop-log checks, there are no openings in the exterior of the Power House below Elevation 300, so that flooding of the plant by abnormal rise of the river may be avoided, and the walls are designed to resist a hydrostatic head up to that elevation.

The succeeding series of photographs, ten in number, illustrate various

comes with an option with which it is possible to include one specific object or  
phenomenon, or affect, and ignore the others. This makes it possible to include a variety  
of existing objects and to add new ones, without adding many. Another advantage  
is that it is not necessary to do any complex spatial transformations with  
geometry, nor does it require any of the complex logic that is required with the  
existing systems. Instead, the problem is reduced to a simple addition, to have  
the system take the current position and the desired position, with the result updated  
in real time and in real time. This makes it possible to make the system work in real time  
and be more efficient. This is the main benefit of the proposed approach. There are  
also other benefits, such as the ability to use the system for real-time applications.  
Y903

Another important benefit of the proposed approach is the ability to add new objects and

(E-69)

stages of progress of the Power House, and, particularly of the substructure. The first six photographs were taken from the top of the cliff looking almost directly down on the structure, and they are numbered E-56 to E-61, and are contained on page E-60, E-61 and E-62 hereof. A study of them will reveal a great many of the salient features already described. The seventh of the series, being No. E-43, page E-63 hereof, was taken from near the same point on the top of the cliff, but looking up the gorge. It shows the relation of part of the completed substructure to the side of the cliff, near the top of which the upper part of penstock No. 1 may be seen in course of erection. The eighth photograph, being E-45 on page E-64 hereof, was taken from the east shore of the river near the bottom of the gorge, looking diagonally downstream at the Power House; while the ninth, E-44 on the same page, was also taken from the low level on the opposite shore, but looking directly at the Power House. The last of the series, being E-45, on page E-65 hereof, gives a detail of the water side of the substructure and the arches over the draft tube passages.

The superstructure is built of steel, concrete, reinforced concrete and terra cotta finished in Portland cement. It covers the substructure, and encloses the whole of the space up to the face of the cliff to the top of the principal roof which is at Elevation 404. The portion over the main units rises in one clear storey, and contains two cranes each with a lifting capacity of 150 tons, so arranged as to be able to handle 300 tons when working together. Within the larger portion of the northerly end of the superstructure are the high tension transformers, switches and bus-bars, located generally on

WALTER J. FRANCIS & COMPANY.  
COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page N-60.

No. N-66

Photograph showing  
Construction of Power House.  
looking from top of cliff.

Taken January 8th, 1921.

C O P Y

No. N-67

Photograph showing  
Construction of Power House.  
looking from top of cliff.

Taken March 1st, 1921.





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WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-61.

No. E-58

Photograph showing  
Construction of Power House,  
looking from top of cliff.

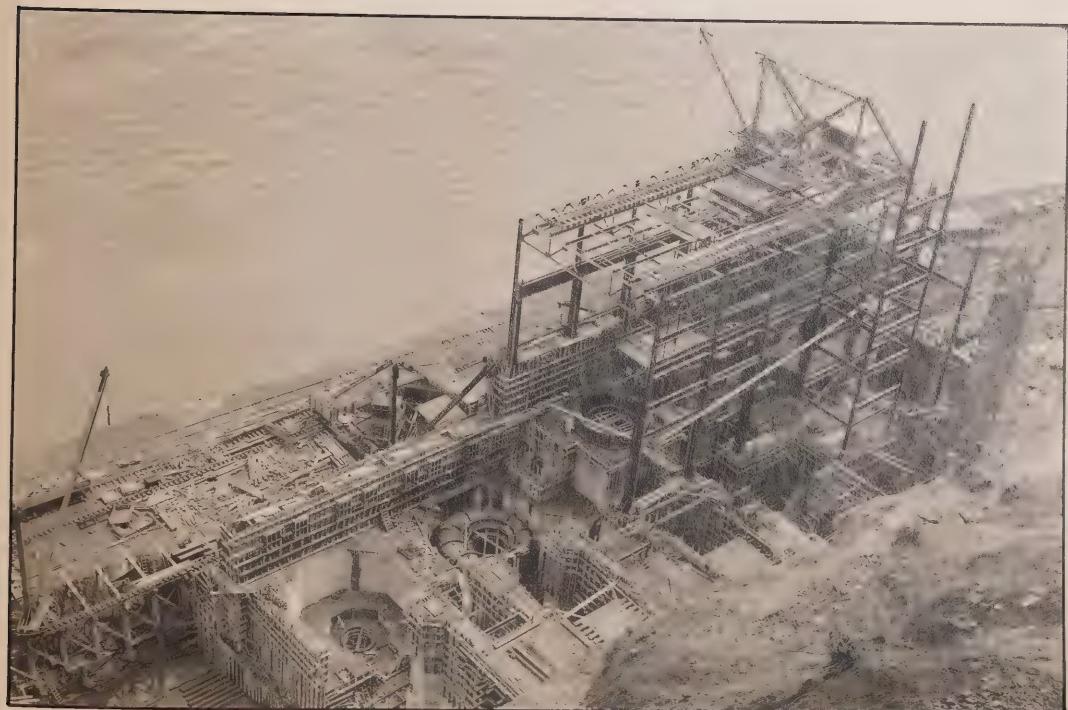
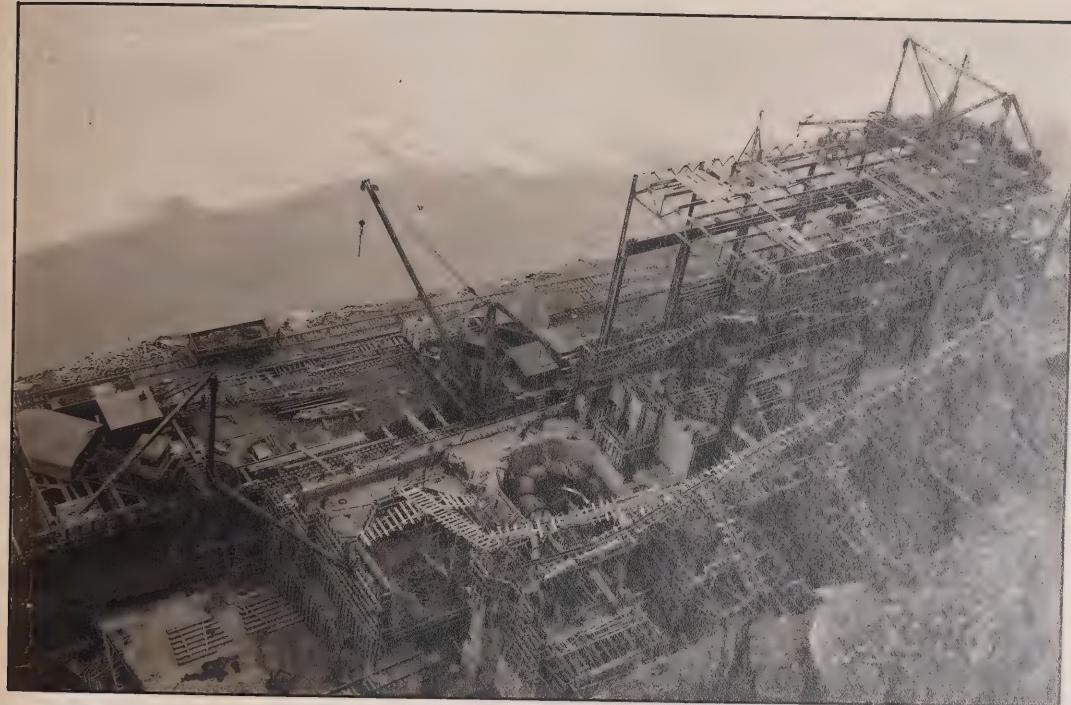
Taken March 22nd, 1921.

C O P Y

No. E-59

Photograph showing  
Construction of Power House,  
looking from top of cliff.

Taken April 8th, 1921.





1900

1900

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page B-62.

No. B-40

Photograph showing  
Construction of Power House,  
looking from top of cliff.

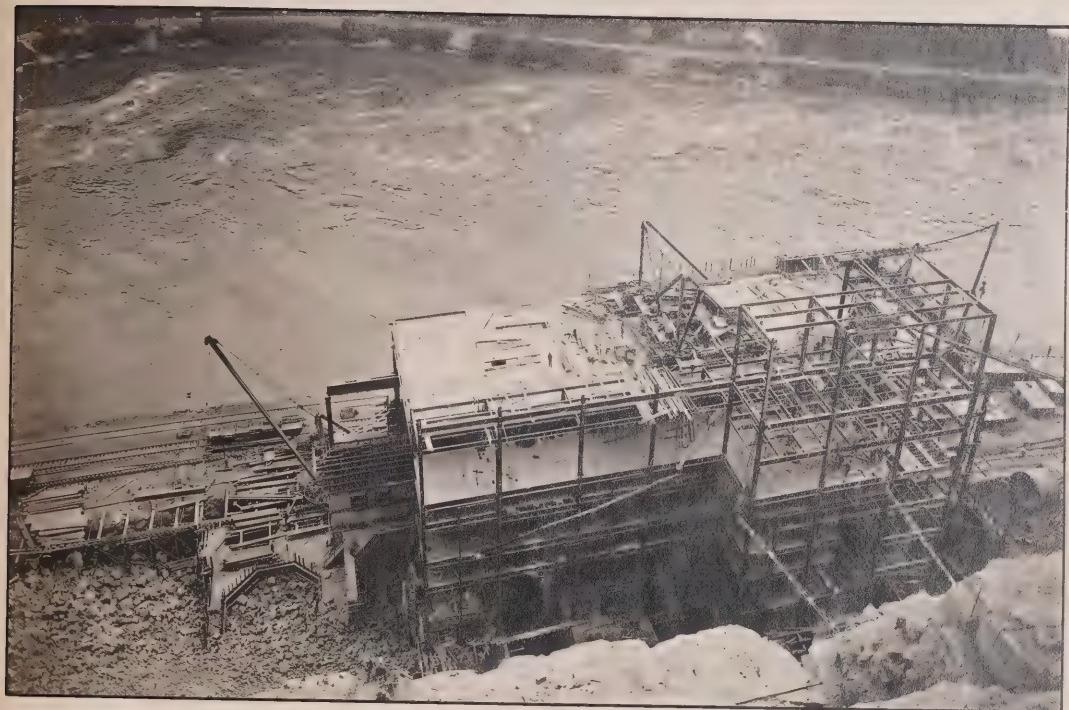
Taken July 8th, 1921.

**C O P Y**

No. B-41

Photograph showing  
Construction of Power House,  
looking from top of cliff.

Taken October 3rd, 1921.





•800 MAIN • L. T. CO. 5089

•800 MAIN • L. T. CO. 5089

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COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-48.

No. E-42

Photograph showing  
~~Construction of Power House and Penstocks.~~  
**COPY**  
looking up Niagara River.

Taken September 1st, 1921.







WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page B-64.

No. B-43

Photograph showing

Construction of Power House.  
looking from opposite shore.

Taken July 20th, 1921.

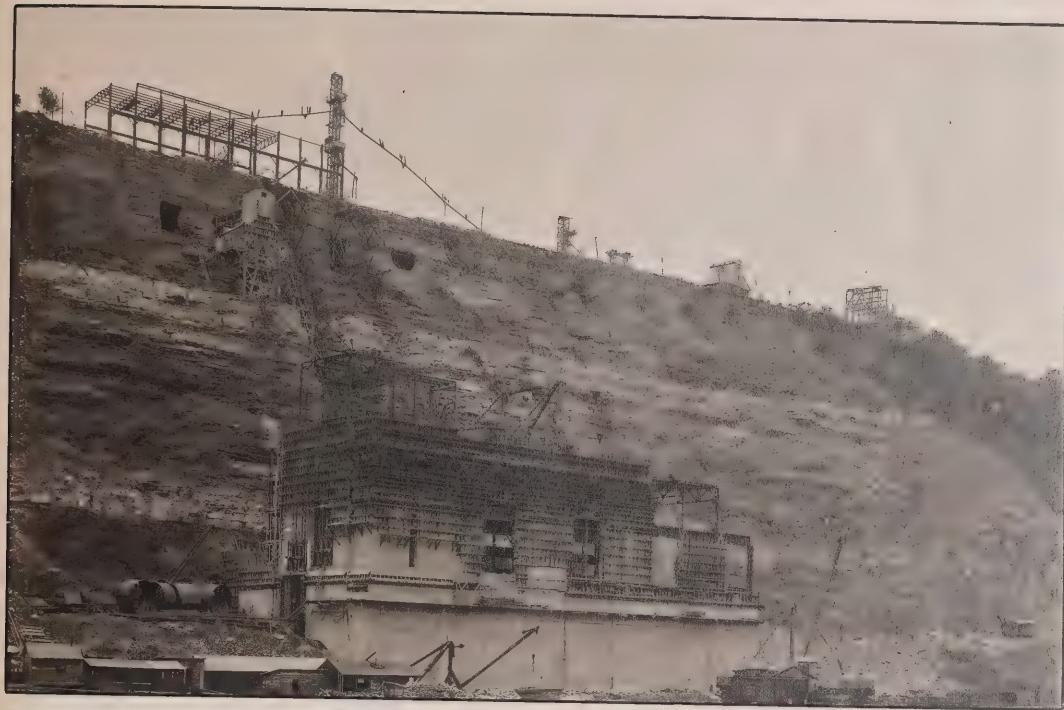
**C O P Y**

No. B-44

Photograph showing

Exterior of South End of Power House.  
from opposite shore.

Taken September 2nd, 1921.





George Washington to Mr. T. ALLEN ROSS.

WALTER J. FRANCIS & COMPANY.

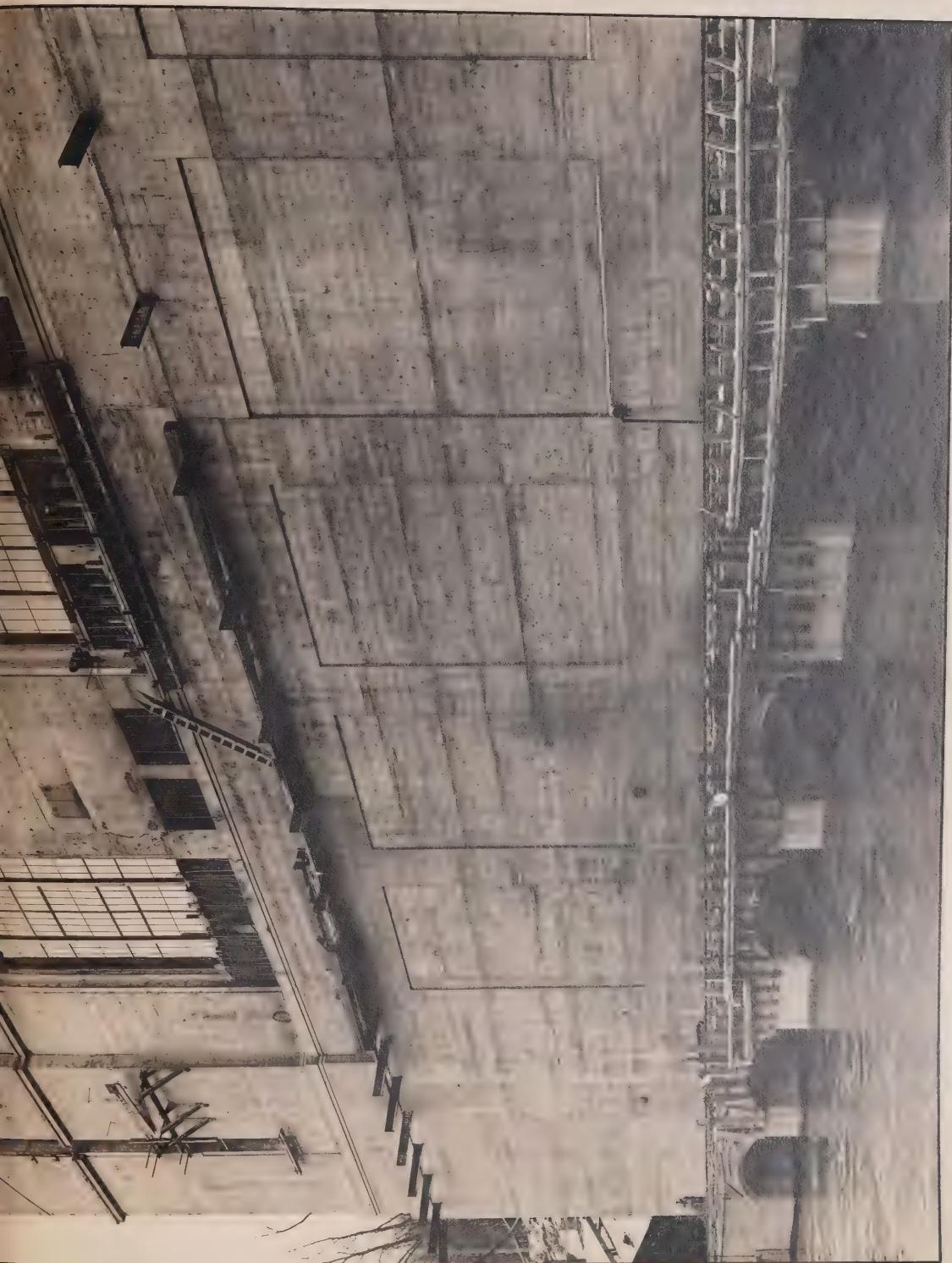
COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-45.

No. E-45

Photograph showing  
Detail of River Side of Power House Substructure.  
COPY  
looking towards draft tubes.

Taken December 28th, 1921.





Marie's Photography  
Book for guidance of Mr. J. VITALE ROSS



WALTER J. FRANCIS & COMPANY.  
COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page D-66.

No. D-46

Photograph showing  
**COPY**  
Power House, Penstock, Dam, House and Canal,  
looking westerly from aeroplane.

Taken September 23rd, 1921.





the three principal floor levels, Elevation 297, Elevation 346, and Elevation 375 respectively, while on the roof are pent houses from which the high tension lines lead to towers and on up over the Screen House. In the southerly part of the superstructure, divided generally into seven floors, are offices, operators' quarters, store-rooms, and so forth, as well as an elevator giving access to the tunnel whereby the offices in the administration building at the southerly end of the Screen House are ultimately reached.

The aeroplane photograph, No. E-66, included herewith as page E-66, shows the Power House in relation to the river, the cliff, the Screen House, the Forebay, and the Canal, as well as the general arrangement of the construction plant, the camp, the sidings and the roads.

COPY

#### Turbines.

The main unit turbines, Nos. 1 to 5 inclusive, are of the vertical shaft, spiral case, single runner, Francis type, operating at 187-1/2 revolutions per minute, with a nominal brake horse power of 58,000 under 305 ft. head. The diameter of the runner is 135 inches, and the diameter of the shaft 50 inches. The scroll cases are made of steel castings, the details of which may be seen by reference to the photograph No. E-47 on page E-68 hereto, and to photograph No. E-48 on page E-69, the former being a view of the case of No. 2, and the latter of No. 4. The turbines for unit No. 1 and unit No. 2 were manufactured by the Wellman-Seaver-Morgan Co., while the turbines for the other three units are being made by the Wm. Cramp & Sons Ship & Engine Bldg. Co., I. P. Morris Department. The governor system for the main units uses

WALTER J. FRANCIS & COMPANY.

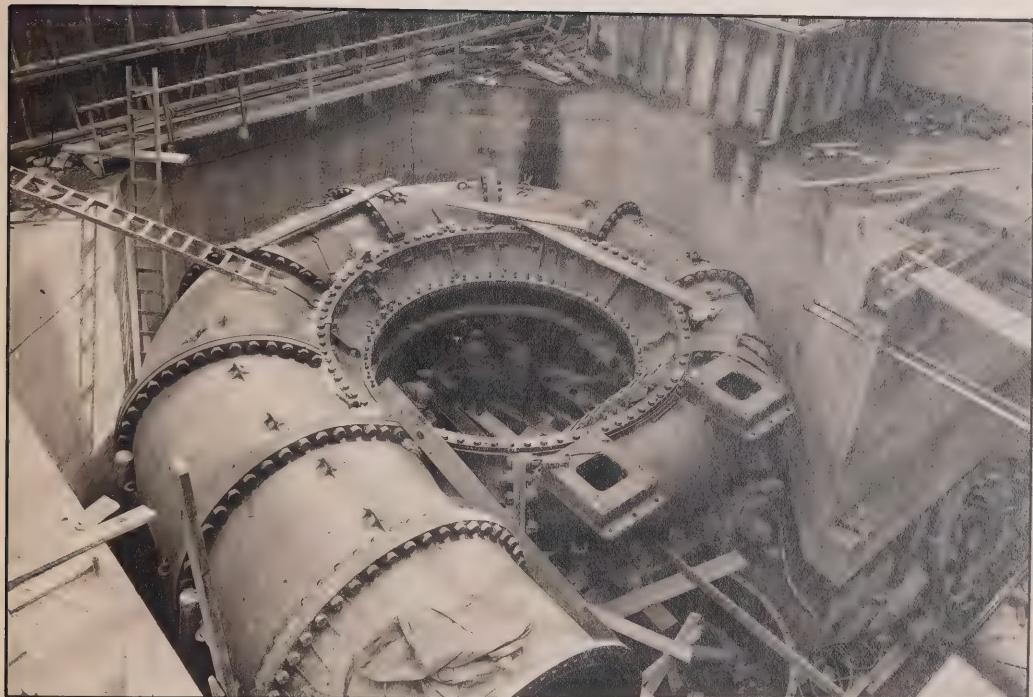
COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-68.

No. E-47

Photograph showing  
Scroll Case of No. 3 Turbine during Erection.  
COPY

Taken April 6th, 1921.







WALTER J. FRANCIS & COMPANY

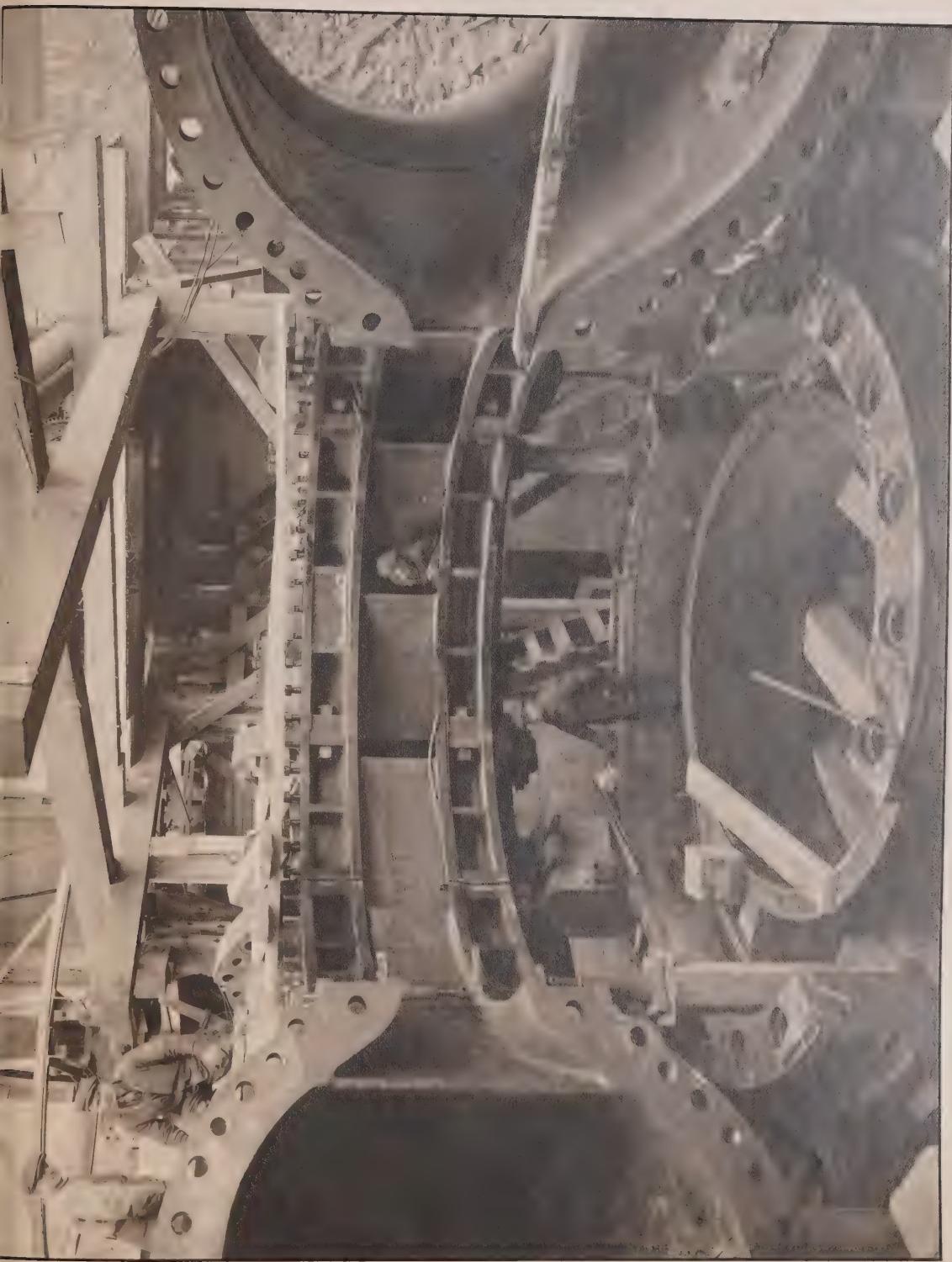
COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-69.

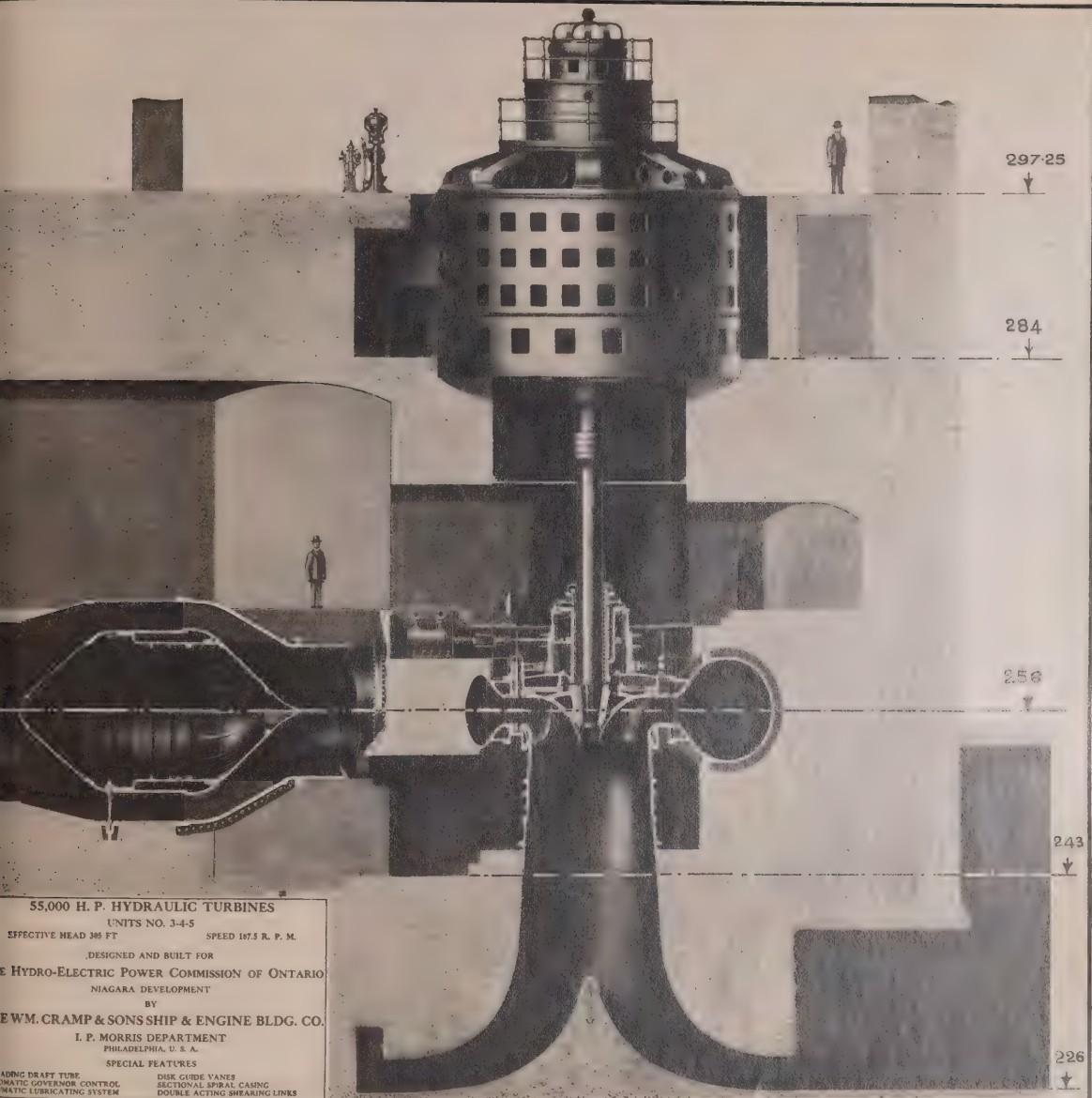
No. E-48

Photograph showing  
Erection of No. 4 Machine Scroll Case.  
COPY  
looking north-westerly.

Taken April 31st, 1922.







ELEVATIONS REFERRED TO H.E.P.C. DATUM      SHOWN THUS.— 256

8 6 4 2 0      5 10 20 30 40

Scale of Feet

HYDRO-ELECTRIC INQUIRY COMMISSION  
W. D. GREGORY—CHAIRMAN  
QUEENSTON-CHIPPAWA POWER DEVELOPMENT  
**MANUFACTURERS' SECTION OF  
MAIN UNIT № 4**  
Scale as Indicated  
Toronto, July 5<sup>th</sup> 1922  
WALTER J. FRANCIS, C.E.,  
CONSULTING ENGINEER



**WALTER J. FRANCIS & COMPANY.**

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

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filtered water containing one per cent. of soluble oil.

One of the latter turbines is shown in complete cross-section in the photographic reproduction of a wash drawing, included herewith as page E-70. This drawing shows the relation of all the principal parts of a main unit.

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The five main generators are each rated at 45,000 kw.e., 80% power factor, 12,000 volts, three-phase, 25 cycles at 187-1/2 revolutions per minute. They are of the vertical type, with direct-connected, shunt-field commutating-pole, 250-volt, ~~C-O-P~~ Rotor. The generators for units Nos. 1, 2 and 3, manufactured by the Canadian Westinghouse Company, have the rotor made with a steel cast spider and a laminated, built-up sheet steel rim; upper and lower bearing brackets of cast iron, provided with the Kingsbury thrust bearing; while the stator is divided vertically into four equal sections. The other two generators, Nos. 4 and 5, manufactured by the Canadian General Electric Co., have the rotor made up of seven steel cast wheels bolted together, the two outer acting only as fly wheels; upper and lower brackets of steel castings, provided with a spring-supported type of thrust bearing; while the stator is divided vertically into three equal sections. The over-all diameter of the main generators is 25 feet, the diameter of the rotor over the pole faces being approximately 18 feet.

The upper photograph No. E-49, on page E-72 hereof, shows the top of generator No. 2, together with the control pedestal and the governor, while the lower picture, No. E-50, on the same page, shows the top of generator No. 1.

After returning from their tour, the two young men were asked if they had any comments to make about their experience. They said that they had learned a great deal about the country and its people, and that they had enjoyed their stay very much.

• 20 •

and, like most other countries, have been employing other methods of  
regulating emissions from oil refineries. The environmental concern about oil refinery  
emissions has been compounded by the recent legislation and the environmental  
problems faced with atmospheric concentrations of sulfur dioxide and benzene. In addition, oil refineries are  
linked with health problems associated with benzene. There are also  
various arguments over what can be done to reduce sulfur levels in gasoline. Some  
refineries argue that their customers should be willing to pay extra  
for refined products with lower sulfur content. Other refineries argue  
that it is not feasible to do this because it would increase the cost of  
fuels. The question is whether the cost of fuel is justified by the benefits of  
reducing sulfur levels.

about 80 Vicksburgans sailed on  
the river to get away from the burning city. Some of them were never seen again.

1905

WALTER J. FRANCIS & COMPANY.

COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page 3-72.

No. E-49

Photograph showing

Top of No. 2 Generator with Control Pedestal and Governor.  
looking easterly.

Taken February 23rd, 1922.

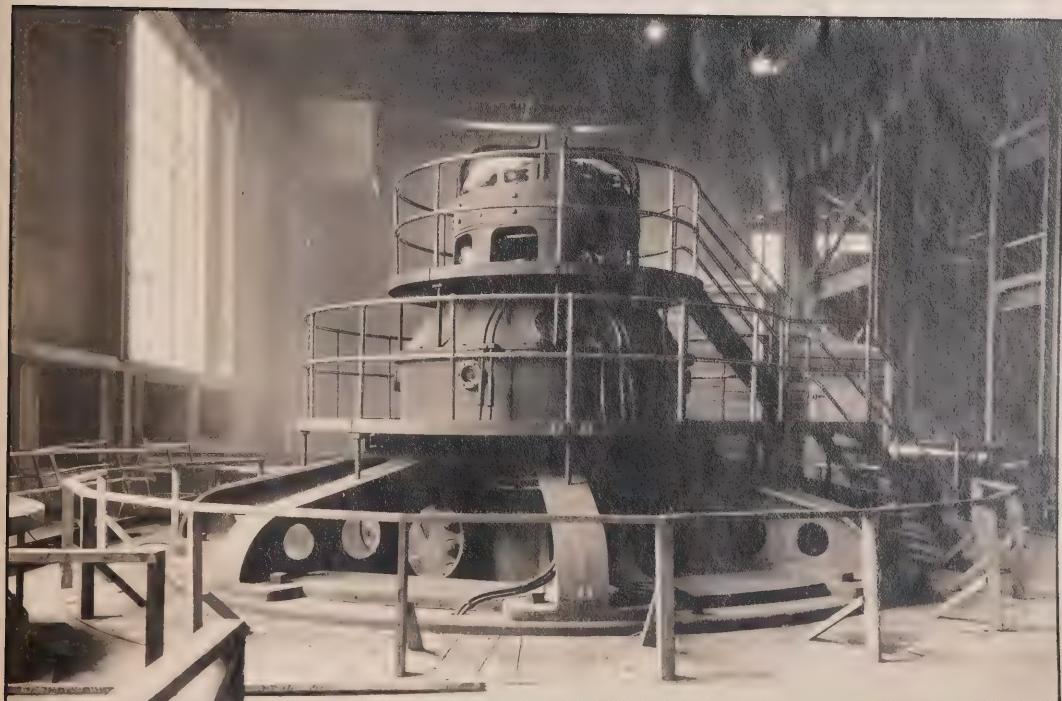
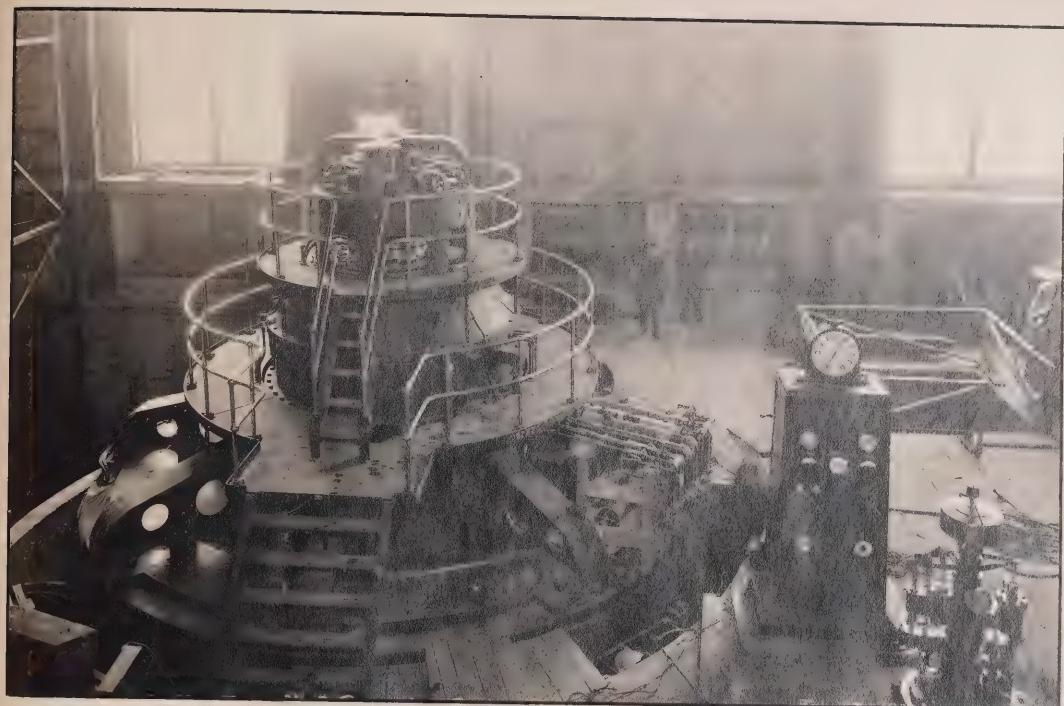
**COPY**

No. E-50

Photograph showing

Top of Generator No. 1.  
looking southerly.

Taken January 5th, 1922.





СВОЯ МАЛЫХ ТЕРРИТОРИИ



WALTER J. FRANCIS & COMPANY.

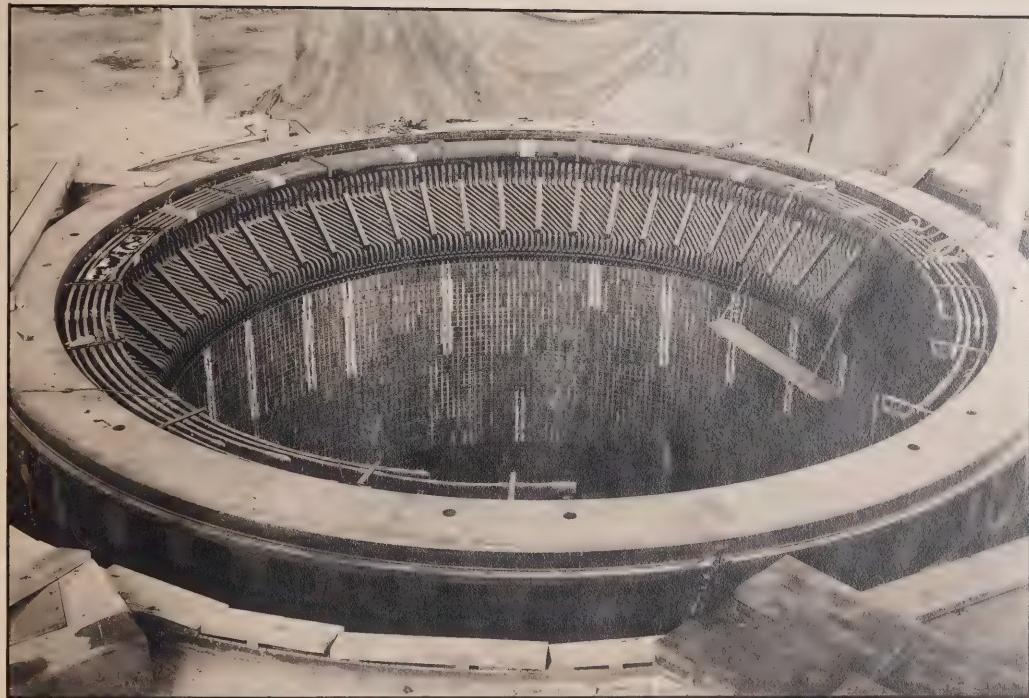
COPY FOR ENCL<sup>O</sup>URE TO MR. J. ALLAN ROSS.

To face page 2-76.

No. 2-51

Photograph showing  
COPY  
Stator of 700 Generator.  
during erection.

Taken September 10th, 1921.





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WALTER J. FRANCIS & COMPANY.  
COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-74.

No. E-32

Photograph showing  
Rotor of Model Memorator,  
ready for installation.

Taken April 4th, 1922.





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(2-75)

Photograph No. E-51, included herewith as page E-73, shows the stator of generator No. 1 in place, while photograph No. E-52, being page E-74 hereof, shows the rotor of No. 5 complete. Reference may be made again to the photograph of the wash drawing included as page E-70 hereof.

#### Service Plant.

The power for the service plant used for pumping, ventilating, lighting and other similar purposes, is derived from two turbines supplied from the service penstock already described. ~~COPY~~ The turbines are rated at 2,500 horse power each at 500 revolutions under 305 feet head, and are of the single runner, vertical-shaft type with cast iron scroll cases. The generators are each rated at 2,200 kw.a., 2,300 volts, 25 cycles at 500 revolutions per minute. A view of one of the service generators with its exciter is given on photograph No. E-55, included herewith as page E-76. The governors use oil and the governor pumps are independent of the main governor system.

#### Auxiliary Plant.

The auxiliary source of excitation of the main units consists of a motor-generator set made up of 250-volt, 150 kw. shunt-wound, direct current generator, with commutating poles designed to carry the excitation of any one of the generators. In the completed station it is contemplated that there will be additional sets, each acting as a spare exciter for a group of machines. The motor-generator sets are driven from the service units.

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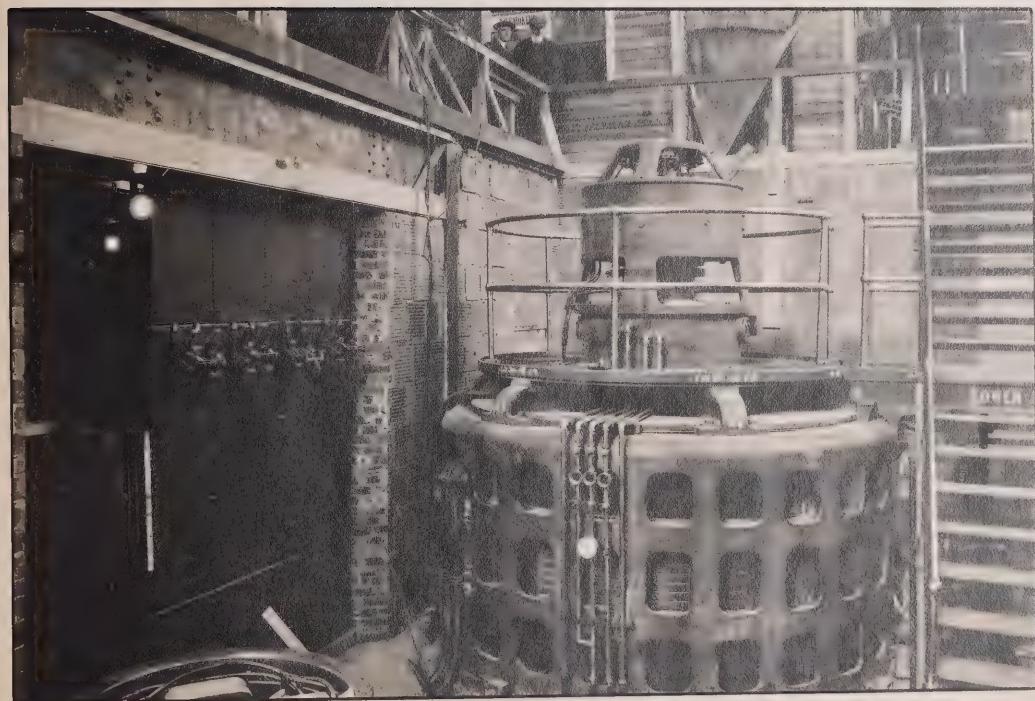
COPY FOR ENCLOSURE TO MR. J. ALLAN ROSS.

To face page E-76.

No. E-55

Photograph showing  
Service Unit "A" in operation.  
COPY  
looking northerly.

Salem February 1st, 1922.





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(5-77)

### Electrical Equipment.

The electrical equipment consists generally of the low-tension switching system, the transformers and the high tension switching system leading to the transmission lines. The apparatus and main connections of each unit are divided into the following groups:

Main generator,

Main 12,000 volt bus,

Auxiliary 12,000 volt bus (when installed),

12,000 volt connections of transformer,

~~COPY~~  
Transformer bank of three transformers,

110,000 volt connections of transformer,

110,000 volt busses.

The installation includes the necessary circuit breakers, relay protectors, reactors and lightning arresters.

The electrical control of the station is centered in the control room situated at Elevation 361 above the generator room, over generators Nos. 4, 5 and 6. The switch controls, indicators and dummy busbars are mounted on bench board sections, arranged in the general form of an arc of a circle, while the indicating instruments are carried on vertical panels at the rear of the bench boards. Further back are the panels carrying the recording meters and the relays, placed face to face.

### Accessories.

In addition to the main governor system, there are complete control pedes-

100-1000

continues to increase in volume. Should we have to apply this concept and limit ourselves to the present situation, we would be compelled to conclude that the quality of the present-day film is declining. However, a more realistic attitude about the present situation is to consider that the present picture is not necessarily bad, but it is not good either. It is not good because it is not good enough to satisfy the needs of the people who are watching it. It is not bad because it is not bad enough to satisfy the needs of the people who are watching it.

100-1000

It is important to remember that the quality of the present-day film is not necessarily bad, but it is not good enough to satisfy the needs of the people who are watching it. It is not good because it is not good enough to satisfy the needs of the people who are watching it. It is not bad because it is not bad enough to satisfy the needs of the people who are watching it. It is not good because it is not good enough to satisfy the needs of the people who are watching it. It is not bad because it is not bad enough to satisfy the needs of the people who are watching it.

**COPY**

100-1000

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(E-79)

Bridges and Crossings.

Provision has been duly made for suitable bridges across the Canal at all points where necessary for the accommodation of highway or railway traffic. There are eight highway bridges and five railway crossings.

Chippawa Highway Bridge.

The Chippawa Highway Bridge is located at the crossing of the Welland River, in the Village of Chippawa by the Chippawa Highway. The new bridge is a permanent structure consisting of one 99-foot bascule span of the Strauss trunnion type, with a 75-foot approach span at each end. The piers and abutments are of concrete founded on rock. The roadway of the bridge is 24 feet wide and there is a sidewalk 2 ft. 6 ins. wide on each side.

Upon the completion of the bridge, it was taken over and operated by the Department of Railways and Canals.

Photograph No. E-65 on page E-80, shows the completed structure with the bascule span partly open.

Michigan Central Railroad Bridge: Chippawa.

At the crossing of the Welland River, in the Village of Chippawa, by the Michigan Central Railroad, a new permanent structure has been provided consisting of a 150-foot swing-span and two half-through plate-girder spans, 79 feet and 74 feet in length at the southerly end of the bridge. The girders rest on

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To face page E-50.

No. E-54

Photograph showing

Michigan Central Railroad Bridge at Montrose,  
looking southerly along west side.

Taken May 4th, 1922.

**C O P Y**

No. E-55

Photograph showing

Oakwood Highway Bridge,  
looking northerly.

Taken May 3rd, 1921.





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(3-61)

concrete piers and abutments founded on rock. The old swing-span, located at this point prior to the improving of the Welland River Channel, was incorporated in the new structure.

Michigan Central Railroad Bridge: Montrose.

At about Station 12, at the easterly entrance to the Canal, is located the double track crossing of the Michigan Central Railroad. The new bridge is of permanent construction consisting of four steel, deck-girder spans 75 feet in length with reinforced concrete piers and abutments. The foundations for the piers consist of steel cylinders sunk to rock and filled with concrete, while the abutments are supported on piles.

The bridge is not yet complete but it is anticipated that it will be ready for traffic by the middle of August, 1922.

Photograph No. E-64 on page E-66 shows the bridge in course of construction; in the background will be noted the temporary trestle provided for the passage of trains during the construction period.

Chippewa Creek Road Bridge.

At Station 25, the Canal is crossed by Chippewa Creek Road. A temporary trestle has been provided at this point and will be utilized during its life. The type of permanent structure by which it will be replaced has not, as yet, been determined.

*Physical Properties*

Water solubility is approximately 10 times that of the alkyl phosphates. The water solubility of the polymer was not very well documented in the literature, and we found no data for the polymer that spans the entire pH range. Therefore, we determined the solubility of the polymer at pH 1.0, 7.0, and 13.0.

*Physical Properties*

The pH dependence of the viscosity of commercial PEG400, a model of the polymer, was measured from 1.0 to 13.0. The viscosity decreased rapidly with increasing pH, and the viscosity decreased further with decreasing pH, which shows that the viscosity of the polymer is strongly pH-dependent. It is believed that the pH-induced hydrolysis of ester groups and their conjugation at pH 13.0 cause the decrease in viscosity.

*Physical Properties*

Figure 3 shows the effect of pH on the density and viscosity against time against the time of the polymerization reaction. At pH 1.0, the viscosity of the polymer decreased rapidly with time, and the density increased rapidly with time. According to the data, the

*Physical Properties*

viscosity increased at pH 4.0 until it reached a plateau, whereas density increased until pH 4.0 and then decreased. In addition, the density and viscosity were constant after 100 h, and the viscosity of the polymer decreased slightly after 100 h. These suggestions are in accordance with the results of the

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(E-63)

Portage Road Bridge.

At Station 249, the Canal is crossed by Portage Road. The bridge which is now in course of construction consists of three 90-foot steel deck, trussed spans and one 30-foot steel deck, girder span with a reinforced concrete floor. The roadway will be 30 feet in width with a 6-foot sidewalk on each side. The piers and abutments are to be of concrete.

It is expected that the structure will be ready for traffic by November, 1922.

**COPY**

Niagara, St. Catharines and Toronto Railway Bridge.

The Niagara, St. Catharines and Toronto Railway crosses the Canal at Station 274. The permanent bridge, which has been completed except for the wing-walls, consists of a reinforced concrete, earth-filled arch, 86 feet span and 25 feet rise.

Thorold Road Bridge.

The Thorold Road Bridge crosses the Canal at Station 289. A permanent structure is being provided, consisting of an 85-foot steel truss in the centre and a 48-foot steel truss at each end, all supported on concrete piers.

The construction of this bridge has not been commenced, but a contract has been let, and it is anticipated that the bridge will be completed by November 1st, 1922. The traffic is at present taken care of by a temporary structure.

1000

1000-2001

and additional 1000-2001 were also taken with 2000-2001. In general, the mean values of 2000-2001 were higher than those of 2000-2001. This is due to the fact that the 2000-2001 sample was taken from the same area as the 2000-2001 sample. Thus the mean values of 2000-2001 were all higher than those of 2000-2001. The following table shows the mean values of 2000-2001.

## YEAR C

Year C is the year when the mean values of 2000-2001 were all higher than those of 2000-2001. The following table shows the mean values of 2000-2001.

1000-2001

Year C is the year when the mean values of 2000-2001 were all higher than those of 2000-2001. The following table shows the mean values of 2000-2001.

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(E-84)

Wabash Railway Arch.

A line of the Grand Trunk Railway, generally referred to as the Wabash Railway, crosses the Canal at Station 310. A reinforced concrete, earth-filled arch of 100 feet span, 25 feet rise and 32.5 feet width has been built at this location. The arch provides for a double track railway.

The photographs included herewith as page E-85, show this bridge under construction and approaching completion, while the photograph included herewith as page E-86, clearly shows the completed structure.

In the background of the letter photograph, there will be noted the temporary structure at the Thorold Road crossing, and also the crossing of the Niagara, St. Catharines and Toronto Railway.

Grand Trunk and Michigan Central Bridges.

At Station 324, the Canal is crossed by the main-line, double track of the Grand Trunk Railway, and by the single track branch of the Michigan Central Railway from Welland to Niagara-on-the-Lake. The bridge consists of a reinforced concrete, earth-filled arch of 72 feet span, 20 feet rise and 156.7 feet width.

The photograph included as page E-87 shows the completed structure.

Boulevard Bridge.

A bridge will be provided in the future, in the vicinity of the Forebay, for the Queen Victoria-Niagara Falls Park Commission Boulevard.

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To face page E-65.

No. E-66

Photograph showing  
Wabash Railway Bridge under Construction,  
looking northerly.

Taken September 3rd, 1919.

**COPY**

No. E-67

Photograph showing  
Wabash Railway Bridge,  
looking northerly along Canal.

Taken January 3rd, 1922.





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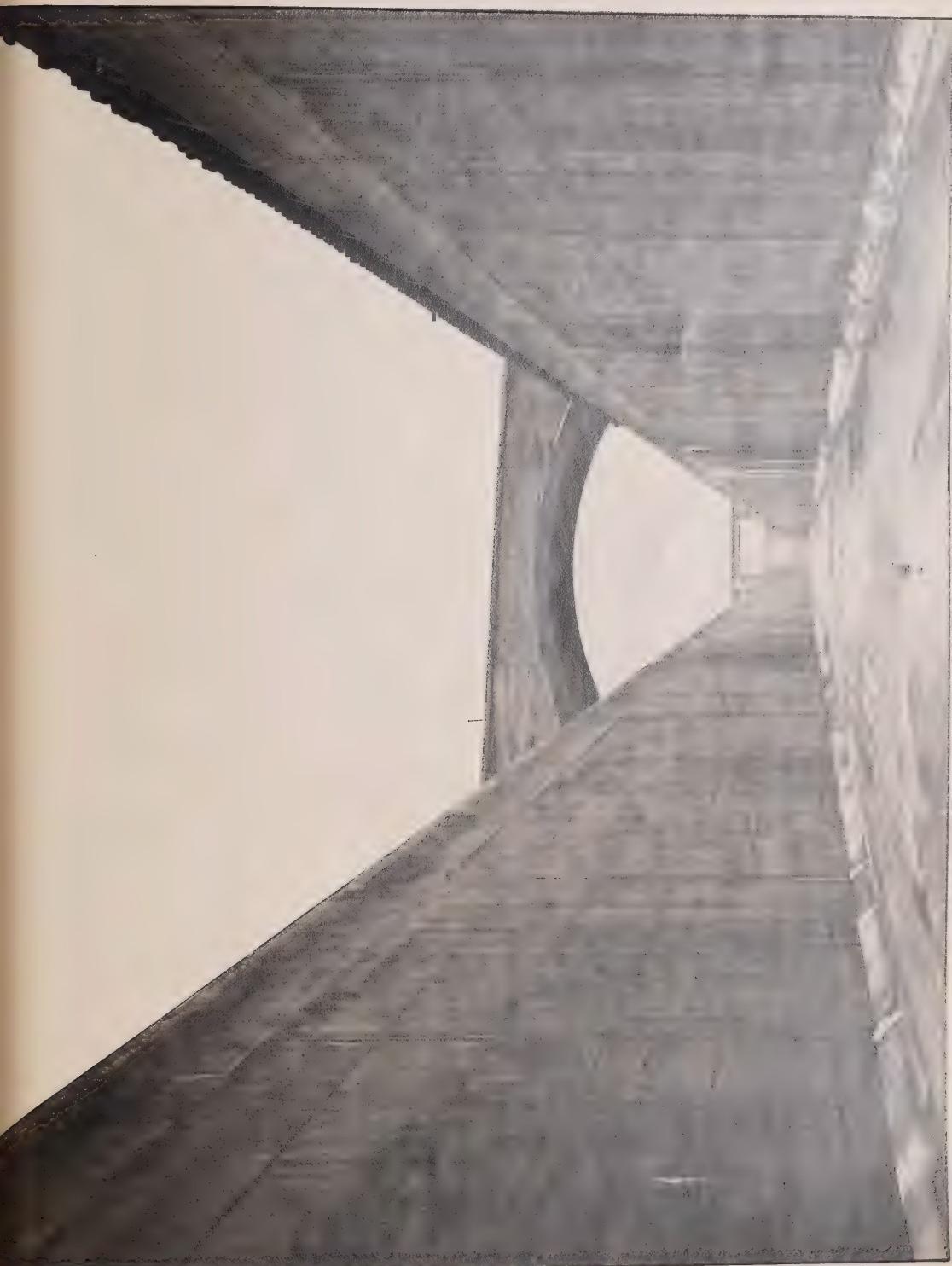
To face page E-58.

No. E-58

Photograph showing  
Completed Niagara Falls ~~Railway Bridge~~ **COPY**

with Thorold Road and N. S. C. & T. Bridges in the Background,  
looking southerly along Canal.

Taken December 23rd, 1921.





1970-1971

1970

1970

1970

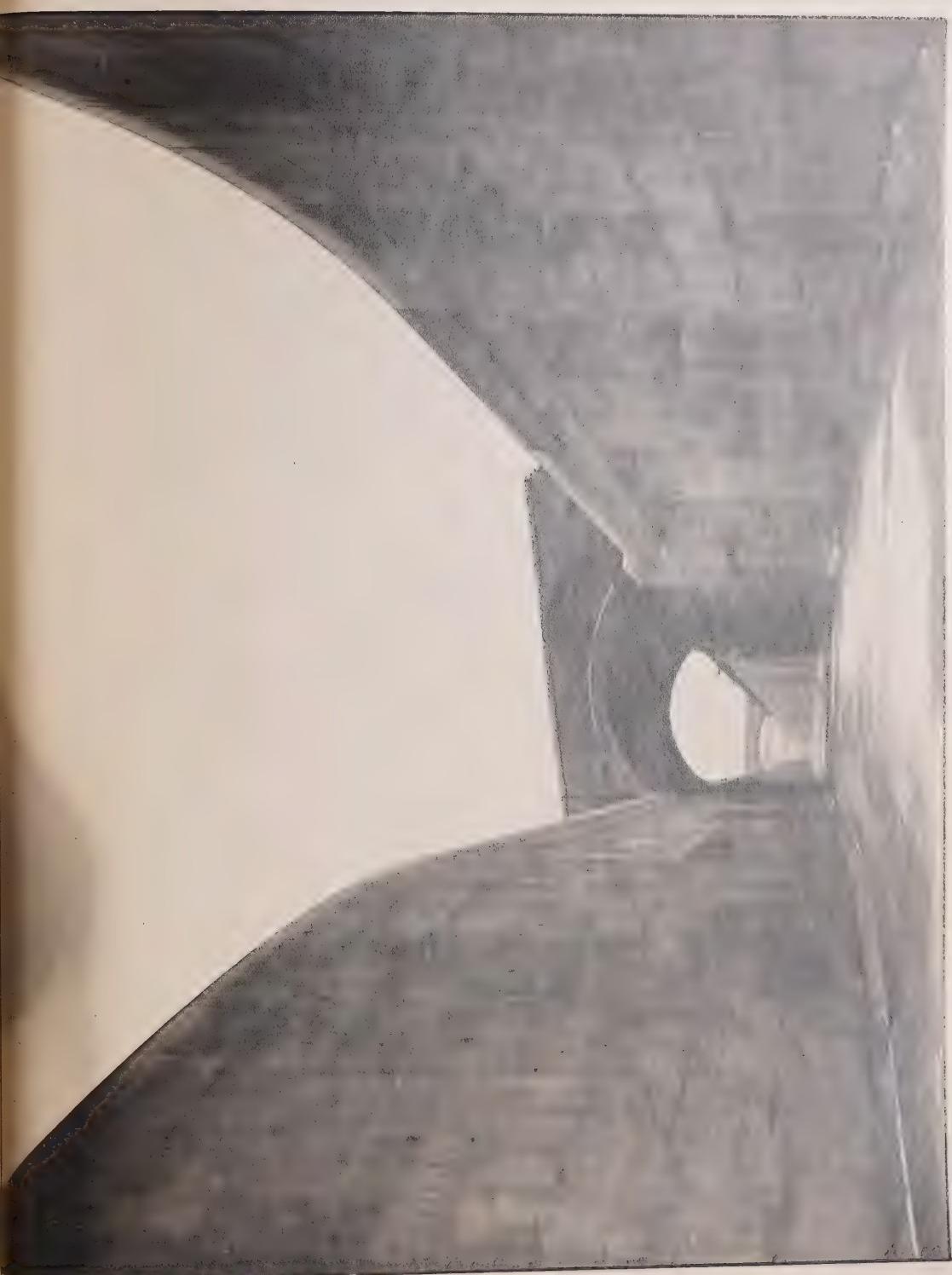
WALTER J. FRANCIS & COMPANY.  
COPY FOR ENCLURE TO MR. J. ALLAN ROSS.

See face page E-67.

No. E-59

Photograph showing  
**COPY**  
Completed Grand Canal - Lionian Central Bridge,  
looking southerly along Canal.

Taken December 23rd, 1921.





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(X-68)

Transmission Line Crossings.

In addition to the bridges described above, there are eight high-tension power line crossings and four low-tension power line crossings. Of the eight high-tension crossings, four belong to the Ontario Power Company, one to the Toronto Power Company, two to the Canadian Niagara Power Company, and one to the Hydro-Electric Power Commission, the latter not being in operation as yet. The four low-tension lines are the property of the Ontario Power Company.

**C O P Y**

~~Right-of-way.~~

Sufficient area of lands were purchased by the Hydro-Electric Power Commission to provide not only a right-of-way for the Canal itself, but also for disposal areas, for the Power House, for construction railways and so forth. In order to avoid "separation" damages in the case of farms, whole properties were purchased in many instances. In some of these cases, the excess lands have already been sold.

The total area of land involved in the purchases is well over 3,000 acres.

As has already been stated, the greater part of the land was either cultivated or used for fruit growing purposes.

Walter J. Francis

*Journal of the American Mathematical Society*

and the first time I have seen a bird which I could not identify. It was a small bird with a long beak and a dark cap. It was perched on a branch and was looking around. I think it might be a sparrow hawk.

YAHOO











